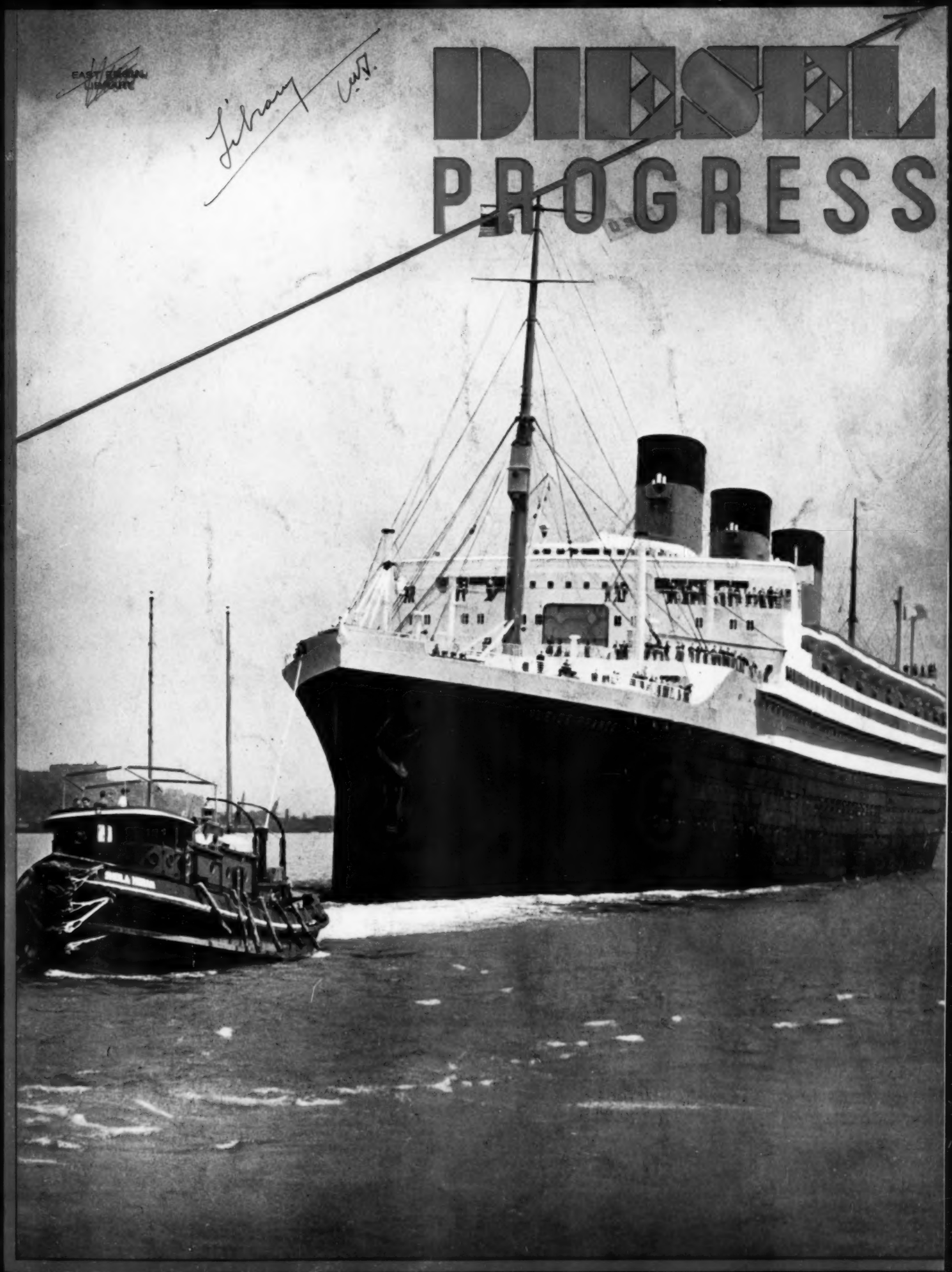


JULY, 1939 CIRCULATION OF THIS ISSUE—IN EXCESS OF 14,000 COPIES 25c

"I'D HATE TO LET MY BEARD GROW 'TIL THAT ENGINE QUITS!" SAYS ENGINEER C. W. HAM

"IT WAS A GOOD ENGINE IN THE FIRST PLACE," says Mr. C. W. Ham, Diesel Engineer for Western Engine Corporation. "We built it ourselves and put it in operation in 1926. It's a stationary solid-injection engine that furnishes us power in rush times 24 hours a day and during its life has never let us down.

"It's still in good shape and produces power for our entire plant at less than the low city rate we could get.

"But the best engine ever built needs good fuel and lubrication. Every drop of oil this one ever had in the crankcase has been your Shell Talpa Oil. Every drop of fuel that's gone through it has been 'Shell Dieseline.' I don't know how *any* products could beat this perfect record regardless of price."

* * *

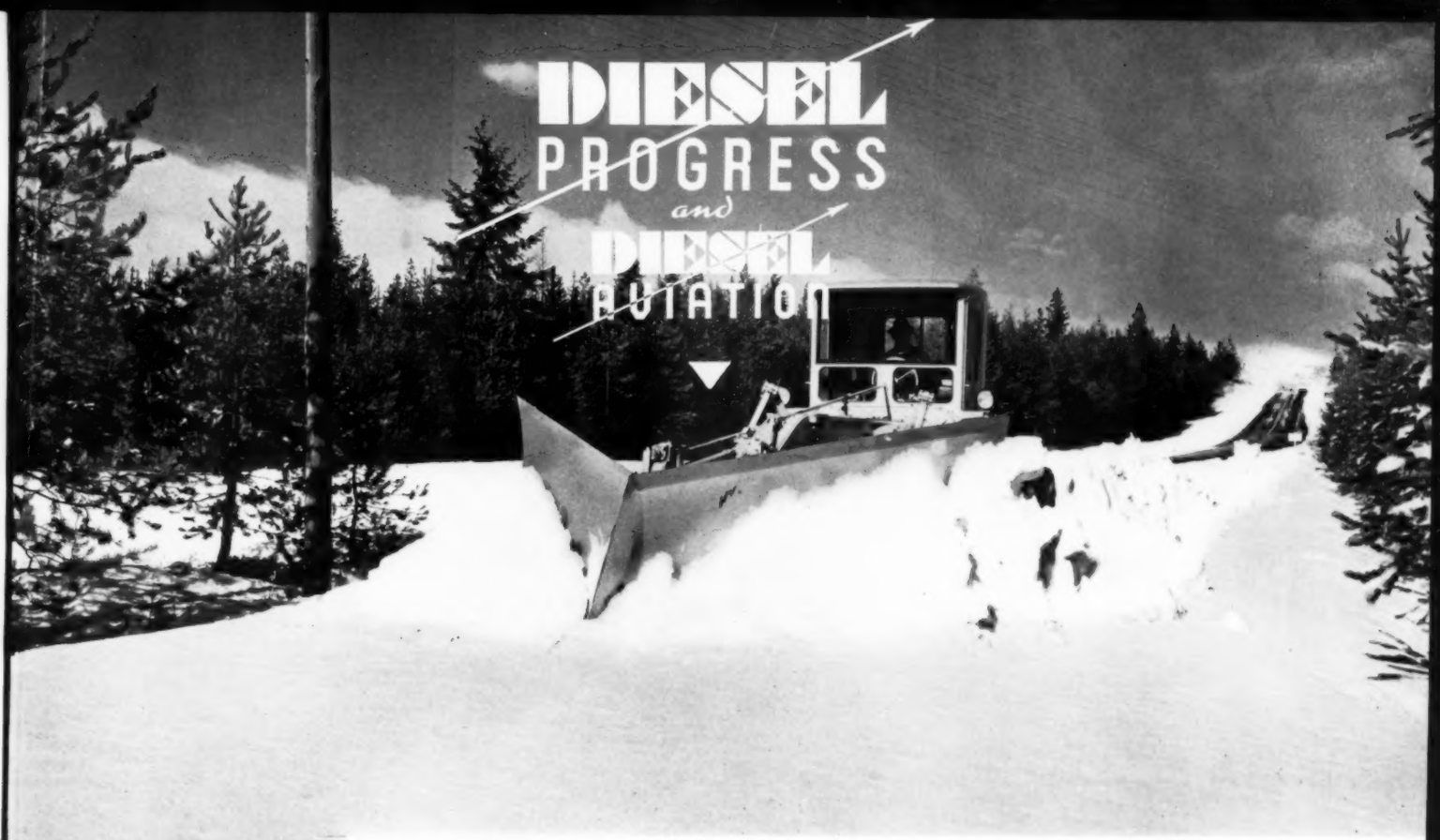
Shell appreciates Mr. Ham's bouquets and is proud to have shared in this record. And while we might add that Shell products can't make bad equipment into good equipment, we do believe they will do the best job that can be done in making any kind of equipment run better and last longer.

Experienced technical men are on call without obligation on all industrial lubrication and fuel problems.

SHELL

SHELL INDUSTRIAL LUBRICANTS

DIESEL PROGRESS for July, 1939. Volume V. Number 7. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Possessions $3.00. Canada and all other countries $5.00 per year. Single copy price 25 cents in U. S. A., 50 cents for all other countries.



REX W. WADMAN
Editor and Publisher

FRONT COVER ILLUSTRATION: The 130-ton, ninety-foot tug *Sheila Moran,* powered by a 900 hp. General Motors Diesel engine, pulling the 43,450-ton 763-foot *Ile de France* down the Hudson on June 7, unassisted, despite a three-knot up-river current caused by the tide.

TABLE OF CONTENTS ILLUSTRATION: The Kootenai County Highway Department, Coeur d'Alene, Idaho, operating a Caterpillar Diesel No. 12 Auto Patrol with the plow clearing snow from paved highway, showing the effectiveness of this type of snow clearing apparatus.

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HEYWORTH CAMPBELL
Art Director

PAUL H. WILKINSON
Aviation Editor

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A RUBBER TIRED RIVER TOWBOAT

By REX W. WADMAN

NASHVILLE, Tenn., June 14. — Here on the Cumberland River this morning I saw something completely new in Diesel marine transmissions — a rubber-tired reverse gear. This day and this demonstration will quietly go down in history as opening a new chapter in the successful application of the so-called high speed engines to heavy duty service.

Shakedown trials were successfully held this morning of the *Bull Calf*, an 88′ x 21½′ x 7½′ all welded, typical river towboat, built by the Nashville Bridge Company for the Canal Barge Company, New Orleans, and powered with a twelve cylinder, model 12-567 General Motors Diesel engine rated at 750 hp. at 660 rpm.

The primary distinguishing feature of the *Bull Calf*, which so aroused my interest and enthusiasm, is the use of an Airflex clutch and a new type of marine transmission developed by the Falk Corporation.

In effect, this transmission is a combination of a reversing Falk marine reduction gear plus the Airflex clutch. It is equipped with two contracting type lined Airflex clutches which provide a flexible and resilient connection between the flywheel and the driving drum mounted at the high speed end of the gear unit. The glands are arranged so that they may be selectively inflated, depending upon the desired rotation of the propeller shaft. An air-controlled valve, with ahead, astern, and neutral positions, is located in the pilot house. It connects to the glands through an air shaft and rotating seal. The control is automatically governed so that it is impossible to inflate both glands together.

As is apparent from Figure 1, the reverse and reduction functions are combined within a single housing. The particularly interesting feature of the new drive is that it takes no more room than ordinarily occupied by a straight reduction gear. In forward rotation, the drive functions precisely as a conventional single reduction unit. The forward clutch is inflated, driving through the ahead drum, which is mounted directly on the pinion shaft.

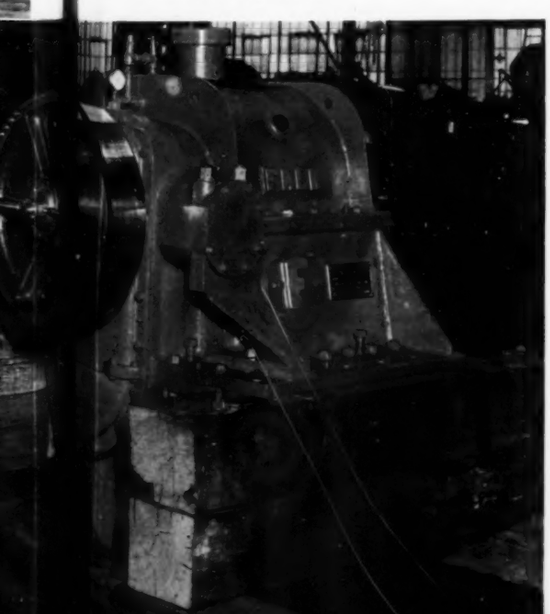
In order to reverse, the pilot control need only be moved from ahead to astern position. This is followed immediately by deflation of the ahead gland and inflation of the reverse gland. The latter picks up the reverse drum which is mounted on a reversing tube concentric with the high speed pinion. The change in rotation is obtained entirely at the high speed end, where the torque is at a minimum value. The loads are still further reduced by the use of a floating double pinion idler arrangement. The reversing pinions straddle the main forward pinion bearing. In this manner the entire reversing elements require little more space than the main thrust bearing which is also located forward and right under the reverse gear train.

The Airflex clutch design in its present form is the result of several years of experimentation. The glands are of multiple cored construction with pre-cured integral tubes. These glands are vulcanized to flanged rims. The inner periphery carries molded-in asbestos lining blocks. The contracting type of clutch has the advantage that the centrifugal force aids in maintaining the blocks in the proper position in addition to exhausting more rapidly. The drums are constructed of special metal alloy with very high heat conductivity which makes it possible to absorb the energy of very rapid reversals safely. The propeller of the *Bull Calf* can be reversed in less than three seconds if necessary.

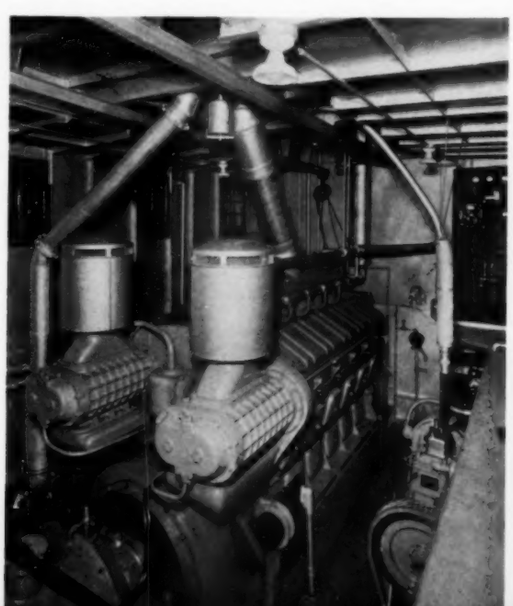
In all other respects the unit follows conventional lines: Gears are single helical; all shafts are mounted on roller bearings; lubrication is by circulating system from a pump driven from a main gear. A Harrison heat exchanger is used for cooling. The housing is of combined cast and welded steel construction.

In the various tests run here this morning, the 131 gross ton towboat was put from full ahead to full reverse in just under three seconds.

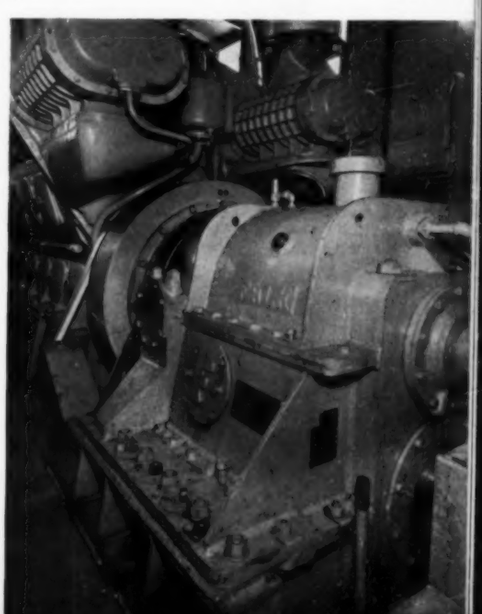
Left — The "Bull Calf," new River Towboat, built by Nashville Bridge Company for Canal Barge Company, powered with a 750 hp. General Motors Diesel engine. Below — Fig 1. Falk Airflex Clutch disassembled, showing two rubber tires with asbestos lining blocks

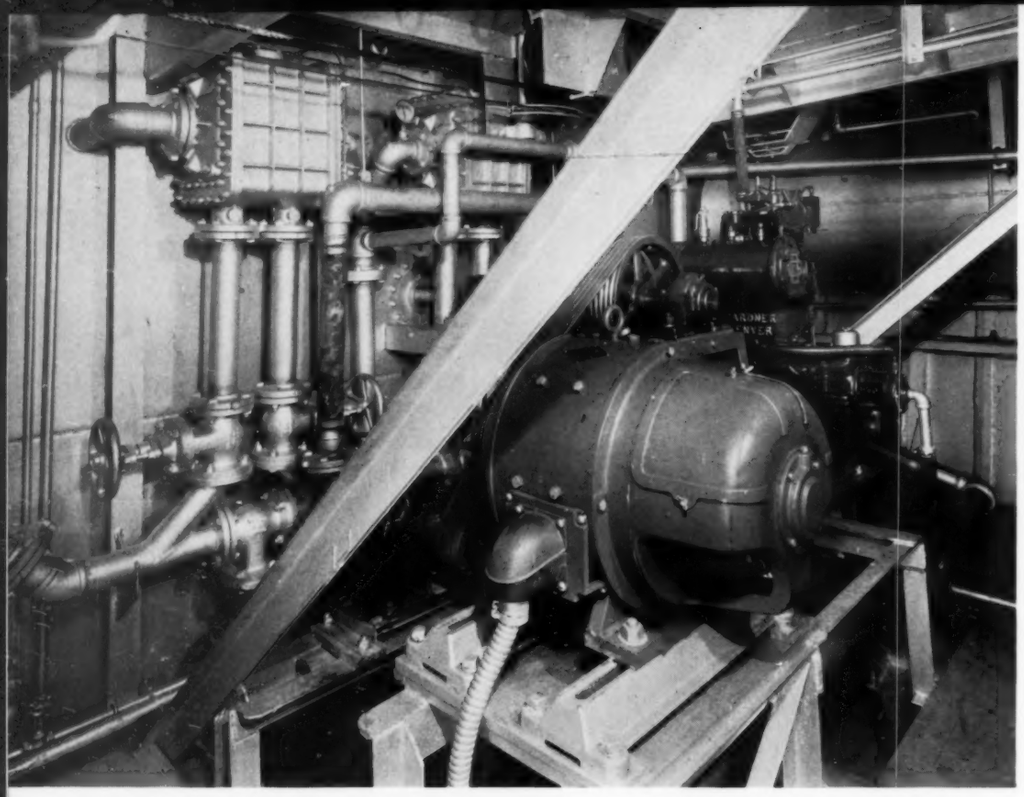


Twelve cylinder 750 hp. General Motors Diesel installed in the "Bull Calf."



Closeup of Falk Reduction Gear and Airflex Clutch as installed on the "Bull Calf."





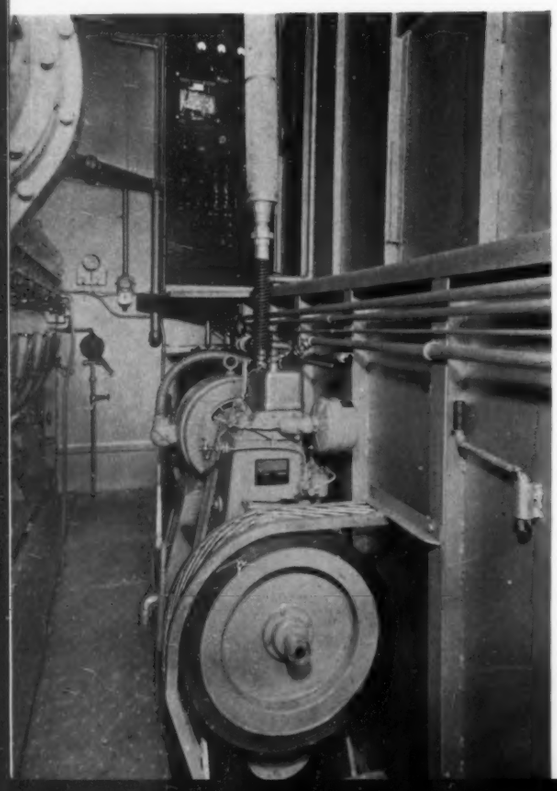
Above — Bridge control — air operated steering mechanism in foreground and automatic engine control right, which also operates rubber tired reverse gear. Left — Fig. 2. Operating Auxiliaries driven from main engine.

Left — Amongst those aboard the "Bull Calf" on her trial run were (left to right) Volney B. Fowler, Public Relations, Diesel Division, General Motors Corp.; Rex W. Wadman, Editor of DIESEL PROGRESS; *H. B. Dyer, Vice-President, Nashville Bridge Co.; G. W. Codrington, President, Diesel Engine Division, General Motors Corp.; Thomas Jordan, President of the Canal Barge Co. of New Orleans; (standing) A. J. Dyer, President of Canal Barge Co.; J. O. Larsen, General Motors Corp., Diesel Division, New York; John B. Saunders, Briggs Clarifier Co., Washington, D. C.; and D. Schwartz representing the Falk Corp., Milwaukee, Wisconsin.*

Every possible combination of ahead and reverse speeds was tried and every time the clutch answered the automatic pilot perfectly. It was an impressive demonstration and I see a tremendous field for this rubber-tired reverse gear in all segments of the marine market.

Getting back to the boat itself: The main engine is a standard twelve cylinder General Motors Diesel equipped with a Delco Remy electric starter; Brown pyrometer; Purolator fuel filters; Jones tachometer on the engine board; Weston tachometer on the automatic pilot control on the bridge.

The standby auxiliary unit is a John Reiner combination — a Stover Diesel driving a 7½ kw. Fidelity generator, a Quincy air compressor and a Northern pump. The operating auxiliaries are all driven from the main shaft of the main engine, in a compartment ahead of the engine room bulkhead. Figure 2 shows how this is done by means of Texrope drive to a Gardner-Denver air compressor, to a 7½ kw. Imperial generator and a circulating water pump. The auxiliary drive is taken off a shaft mounted on a pair of SKF roller bearings. In this same room are located the Harrison heat exchangers for the main engine.



Reiner auxiliary unit on "Bull Calf," Stover Diesel, Quincy air compressor, Northern pump and 7½ kw. Fidelity generator.

Lubricating oil is clarified and conditioned by a large Briggs clarifier in the engine room — a model 4-P-8-90 with 150 gpm. flow capacity.

Crane valves and fittings are used throughout the vessel. The Electric Products Company supplied the battery charging and voltage regulating unit which maintains standard voltage throughout all fluctuations in engine speed.

Steering is by means of an air turbine located aft in the shaft alley. The ship instantly answers the helm from the long lever located aft of the big auxiliary steering wheel in the pilot house.

All in all, the *Bull Calf* is a sturdy, dependable river towboat and will give a good account of herself in service between Vicksburg, Memphis, and New Orleans. We will look back on this somewhat prosaic little work-boat as pioneering a new and revolutionary type of marine drive. My hat is off to the initiative and progressive thinking of her owners, the Canal Barge Company; of her builders, the Nashville Bridge Company, the engine builder, the General Motors Corporation and the Falk Corporation for the Airflex clutch — it is this pioneering spirit which spells PROGRESS, and we are happy that DIESEL PROGRESS is the first magazine to publicize this new achievement.

DIESEL AVIATION

Final assembly lines of Junkers Jumo 205 Diesels at Kothen, where thousands of these engines have been built.

PROGRESS IN DIESEL AVIATION IN GERMANY

By PAUL H. WILKINSON

The second in a series of articles written from the field of Europe

BERLIN, June 10—Visits to the various centers of Diesel aircraft engine activity in Germany show that beyond a doubt, this type of power plant has come to stay and its use will be considerably increased when more powerful engines are available. Already, thousands of Diesels of 600 hp. and 700 hp. have been built and put into service. Diesels of 1,000 hp. and up are now required and as soon as they are available in quantities, further Dieselization of German aircraft will take place.

At the Junkers factory at Dessau, small series production of the 700 hp. Jumo 205-E Diesel is in process and a number of 205-D engines are also being built. The 1,200 hp. 6-cylinder Jumo 206 Diesel is undergoing its flying tests and preliminary series production is due to start soon. The 2,000 hp. square-type engine is progressing toward the test stand stage and should be ready for its power runs by the end of the year.

At the large production factory at Kothen where thousands of 600 hp. Jumo 205-C engines have been built, there is little Diesel production at the moment while the change over to more powerful engines is being made. Exhaust-driven superchargers are being applied to the latest engines with excellent results and the present relatively high specific weight and relatively low take-off power of the engine will soon be things of the past.

While at Dessau, the aviation editor of DIESEL PROGRESS had every facility placed at his disposal to see how Jumo Diesels are built and tested, and how the development of new models is carried out. An interesting flight in a Diesel-engined Junkers Ju 86 plane belonging to Dr. Koppenberg, head of the Junkers organization, proved conclusively that the Diesel starts easily, accelerates well and is quiet in operation. Furthermore, there is no vibration or rough running. These, and other important points relative to the manufacture of the engine, will be dealt with in an early issue of this magazine.

Conflicting reports have been circulated regarding the period between overhauls for the 600 hp. Jumo 205-C Diesel and so a visit was made to the Deutsche Lufthansa repair shops at Staaken to ascertain the facts. There it was found that a 250-hour period is now common practice between overhauls, and that approximately 540 man-hours are required for a complete overhaul. These figures are based on an engine cruising output of 70 per cent and a fuel consumption of from 0.352 to 0.363 lb. per hp. per hour. After overhaul, the engines are tested at speeds varying from 1,000 to 2,200 rpm. for 8½ hours before they are again installed in the airplanes.

The most impressive project in Germany devoted to civil aviation is the new air city of Flughaven at Tempelhof on the outskirts of

Above — Model of the loading platform at the new air city of Flughaven (Tempelhof), Berlin. Twelve large four-engined airliners can be accommodated at one time under the cantilever roof.

Above — Ready for a trial flight in a Diesel-powered Junkers Ju 86 at Dessau. Left to right — Dr. Flucke (Junkers Co.), Mr. and Mrs. Paul H. Wilkinson, Mr. Hoener (Junkers Co.).

To the Right — The "Seefalke," one of the Deutsche Lufthansa's new Dornier Do 26 flying boats powered with four 700 hp. Jumo 205-E Diesels.

Berlin. Here soon will be the center of Diesel-engined aircraft activities in Europe. Although the flying field and the approaches are not yet completed, a number of the offices are now in use by Deutsche Lufthansa as their headquarters. The size and magnificence of the structures must be seen to be fully appreciated. The booking hall is comparable to the one in Pennsylvania Station, New York. The thousands of offices, arcades for shops, underground transportation, covered loading platforms for the planes, and huge restaurants and accommodations for 100,000 people on the roofs of the buildings are outstanding examples of intelligent planning for the future. By comparison, the buildings at North Beach Airport at New York are puny and obsolescent.

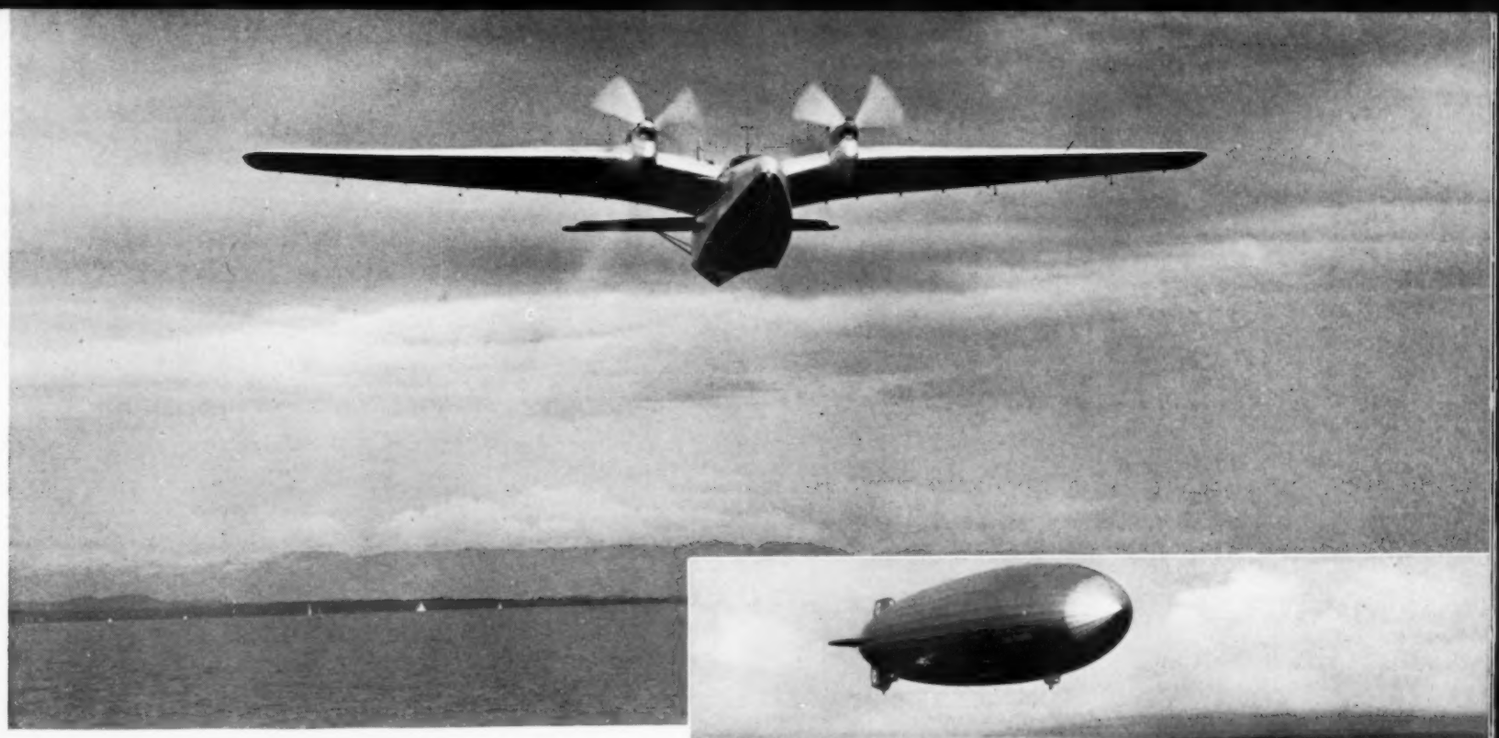
A short visit to Friedrichshafen on the shores of Lake Constance, revealed that Diesels are much in evidence at the Dornier factory. A number of *Do 18* patrol flying boats, powered with two Jumo 205 Diesels, were being completed for the Luftwaffe (Air Force), and a *Do 24* flying boat, equipped with three 700 hp. Jumo 205-E Diesels, was ready for its flight tests. Deutsche Lufthansa has several *Do 26* flying boats on order equipped with the last-mentioned engines, and these are being completed as quickly as possible for mail and limited passenger service across the Atlantic.

The Dornier museum is well worth seeing, as it shows the progressive development of all-metal planes from the earliest designs of Dr. Dornier. The scale models and photographs are excellent, and even the early construction details compare very favorably with present-day conceptions of all-metal construction.

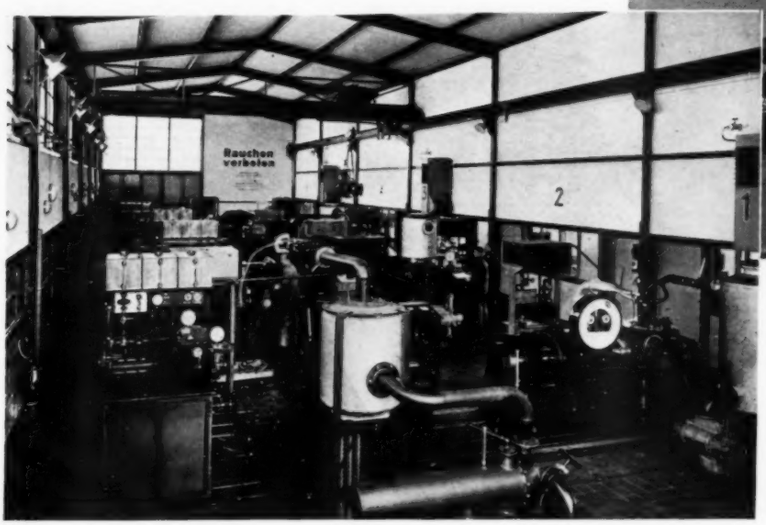
Another interesting museum at Friedrichshafen is the one which shows the progressive development of the Zeppelin from the time the *LZ-1* in 1900 to the *LZ-130* completed in 1938. Some very fine models and photographs are to be found in this new, ultra-modern building. Many parts of the modern airship are on display, including a 1,200 hp. Mercedes-Benz DB 602 Diesel similar to those used on the latest airships.

The *LZ-130*, the *Graf Zeppelin*, is now stationed at Frankfort-on-Main where it awaits a supply of non-inflammable lifting gas which will enable it to be operated for passenger service. A tour of the airships reveals that it is luxuriously equipped for the transportation of 45 passengers over long distances. Even the bed linen, the dishes, the silverware and the glassware are on board ready for use. By no stretch of imagination can the *Graf Zeppelin* be considered to be a dangerous military weapon, and yet on account of the foolish jealousy of certain interests, the United States has not been permitted to carry out its agreement to sell the necessary helium for the operation of the airship. In time, it is expected that sufficient non-inflammable gas will be obtained from another source for the *Graf Zeppelin*.

Daimler-Benz of Stuttgart, builders of the airship engines, do not have much to report regarding their Diesel development. Details of the Mercedes-Benz DB 602 Diesel have already appeared in this magazine. This firm has perfected direct full injection for its DB 600 and



Views at Friedrichshafen. Upper – the "Seefalke" after a take-off. To the right – The LZ-130 "Graf Zeppelin" cruising over the city.



Interior of one of the test houses at D.V.L., the German Aircraft Research establishment at Adlershof, Berlin. There are twelve pieces of testing apparatus in each test house.

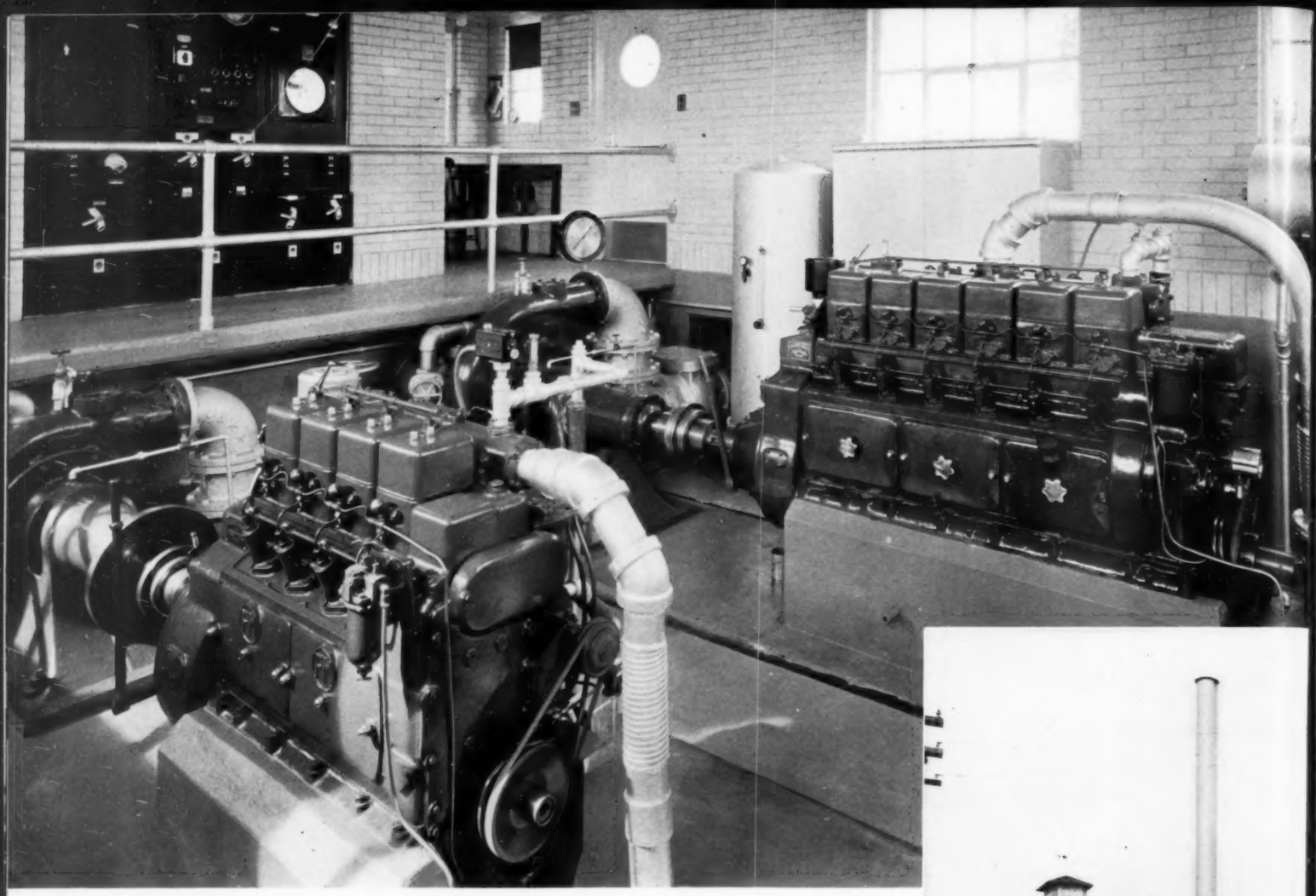
DB 601 gasoline airplane engines, and it is quite possible that these engines are now being converted to Diesel operation.

At Munich, the B.M.W. factory is extremely busy with the production of gasoline aircraft engines of the air-cooled radial type with direct fuel injection. The Bosch pumps used on these engines are similar to those on the B.M.W.-Lanova 114 V-4 Diesels built by this firm. Diesel development is considered to be an important item and it is not being neglected. A visit to the laboratory of Franz Lang on the opposite side of Munich disclosed his close cooperation with B.M.W. for the past 40 years. In a future issue of DIESEL PROGRESS, the work of this worthy pioneer will be described in detail.

This article relative to the progress of Diesel aviation in Germany would not be complete without reference to the excellent work being done by the D.V.L. (German Aircraft Research) establishment at Adlershof, Berlin. At this extensive and up-to-date center, several Diesel test engines were under investigation and exhaust-driven superchargers were also being tested under conditions simulating flight operations at 20,000 ft.

In another building, atmospheric conditions up to 40,000 ft. were duplicated. The experimental test houses at D.V.L. are particularly well equipped, each of them containing twelve double test beds on which twelve pieces of apparatus can be tested simultaneously while twelve more pieces of apparatus are being prepared for testing.

Such is the status of Diesel aircraft engine development in Germany, based on personal visits to the various firms and establishments referred to in the text. While particulars of these accomplishments have been released for publication, there are, of course, others of a confidential nature which are considerably more advanced. There can be no doubt but that at the present time Germany leads the aviation world in the development and practical application of the Diesel aircraft engine. This is due to two things – adequate government assistance and a true spirit of pioneering.



Interior view of the new section of the Cape May sewage pumping station showing two Fairbanks-Morse Diesel engines direct-connected through Falk Steelflex couplings to horizontal non-clogging pumps.

DIESEL SEWAGE WORKS

By E. SCHOONMAKER

THE March of Time caused more than a mechanical crisis in Cape May, New Jersey, when last summer the old Madison Avenue sewage pumping station became wholly inadequate through obsolescence. The old gas engines, needing constant attention, could not be operated for more than two periods a day. The pumps, as a result, could not handle the flows resulting from normal growth and the natural increase in population. As the sewer lines in reality became an overflowing collection system, it created a serious health menace. What to do in the public interest was suggested by Perring & Remington Company, Consulting Engineers, of Camden, N. J., and Baltimore, Maryland, who had been engaged to conduct a thorough survey. They recommended a new works so regulated as to have a capacity varying from 0.5 mgd. to 5.5 mgd., which the City Fathers approved. To achieve this and to guarantee simplicity and dependability, every practical method of performance was considered before final unanimous decision was made on Diesel engines direct-connected to non-clogging, horizontal sewage pumps of the same make.

The installation of a Fairbanks-Morse, 4-cylinder, Model 36, 4¼ Diesel engine, direct-connected to a 6 in., 1,200 gpm. sewage pump and a Fairbanks-Morse, 6-cylinder, Model 36, 5½

Diesel engine, direct-connected to an 8 in., 2,800 gpm. sewage pump, was completed late in 1938. Thus began a new cycle of performance in which these Diesel engines and pumps provided a maximum range of speed regulation without the use of speed reducers. By eliminating all mechanical conversion losses in this manner and coupling this operating advantage with sewage influent regulation the entire demand is handled with the minimum amount of equipment. In this way, the Engineers gained many worthwhile investment and construction economies without impairing utility. These values, of course, were not obtained without some degree of ingenuity, and naturally the City Council is delighted with the resulting low rate of $1.50 for pumping one million gallons of sewage out into the Delaware Bay, approximately 19,000 ft. distant. Some idea of the anticipated pumping costs, based on other conditions than prevail at present, can be figured from the following:

Average summer flow	1,500,000 gallons
Average winter flow	1,000,000 gallons
Normal rainy weather flow	3,000,000 gallons
Heavy rainy weather flow	4,000,000 gallons

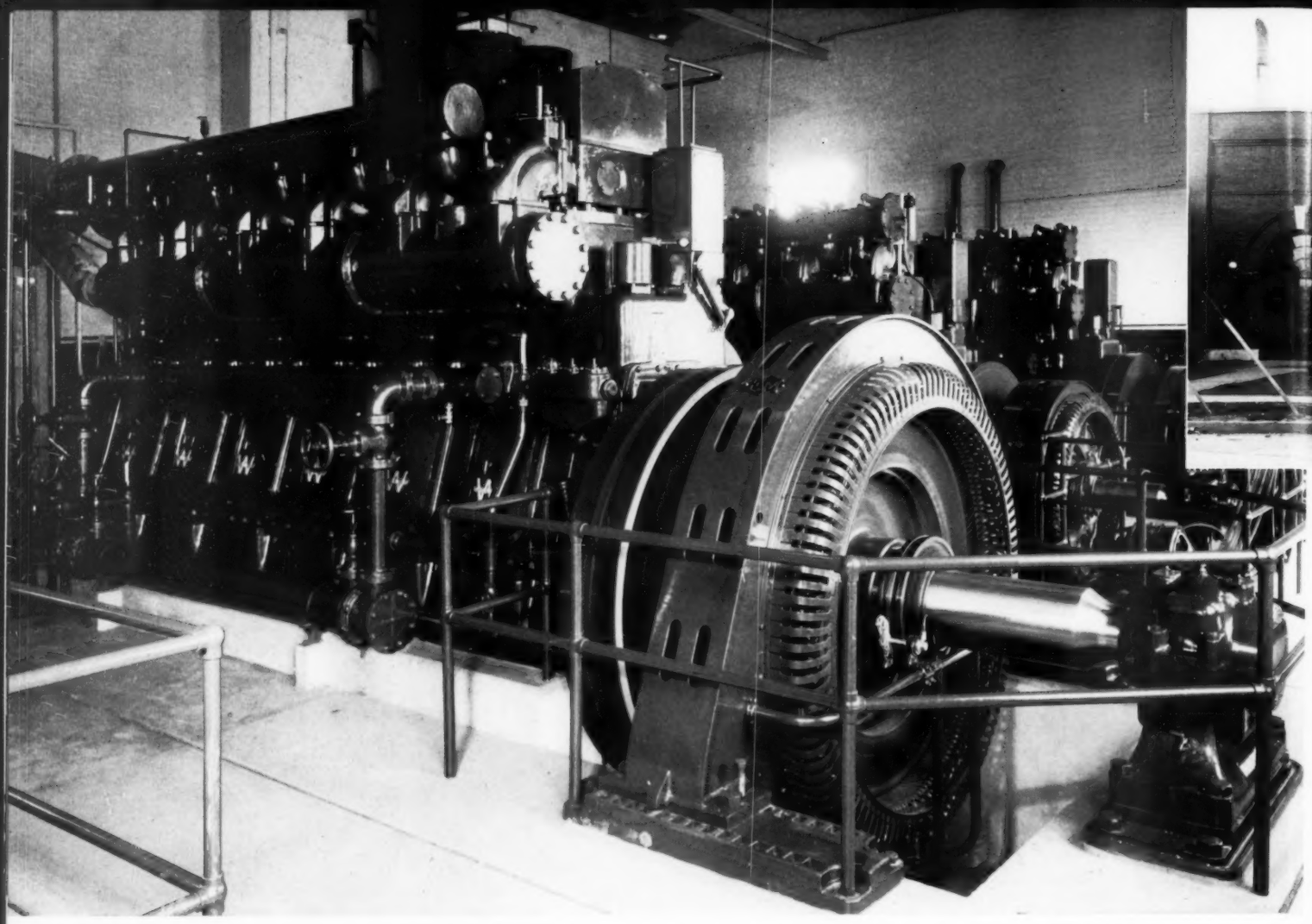
The foundations for this equipment were not built until the Engineers had conducted a series of test borings. This was considered necessary on account of the proximity of so much sand and water. As a result, Perring & Remington Company specified special "piling" foundations, which were put in and insulated from the building by cork and bitumastic foundation mats and side walls. By installing the engines and pumps in this manner, it averted the possibility of future misalignment and reduced vibration to the near perfection mark. Coupled with the fact that adequate Maxim exhaust silencers were used on each engine, a very quiet installation was established. The use of other simple operating safeguards also contributes to "top" engine performance. Such devices as an automatic engine howler, warning against insufficient cooling water and lubricating oil, are installed. The bearings of each sewage pump are protected by a positive supply of cooling water automatically furnished by a Fairbanks-Morse pressure system. A Schwarze electric alarm also indicates the high and low water levels in the receiving wells, so that operating adjustments can be made at the critical points as the occasion demands. The quality of performance is further enhanced by the use of De Luxe lube oil filters, two on the small engine and three on the larger engine; and Purolator fuel oil filters on each engine, Burgess air cleaners, D.P.S. thermometers, and Detroit Lubricator thermostatic circulating water controls. The engines are electrically started, using Exide 24 and 32 volt batteries, and Leece Neville starting motors. Reliance tachometers are also installed for checking the speed of each engine, and a Brown pyrometer indicates exhaust temperatures of both engines.

Right — View of the modern building which houses the new Diesel installation. Below — The obsolete gas engines replaced by up-to-date Diesel engines and pumps.

The pumps, operating with 20 ft. suction lift, are also safeguarded against lost suction by the manipulation of check valves in the suction lines. This obviates the necessity of using the Nash Primers installed on each pump, which are designed for intermittent service.

The advantage of operating, according to demand, saved further construction costs when it became unnecessary to enlarge or add to the present receiving well. This fitted in with the Engineers' plan to make the screening and grit chamber an integral part of the suction well. Reached by a spiral stairway, it includes a chain hoist for removing screenings; adequate air duct to the ventilation stack in the rear of the plant; grit chamber; hopper bottom grit channel; inverted rake cleaning attachment; gas-tight roofs over the wells, moisture-proof float switches operating motorized 30 x 36 sluice gate and water level indicators and alarms. Combination stop plates and adjustable weirs are also installed in the 18 in. discharge channel to the suction wells. This permits the diversion of sewage into either pump suction compartment and the control of the sewage level within the screening chamber.

The engines, pumps, switchboard, and accessory equipment are installed in a super structure immediately adjacent to the well housing, all of which was constructed by Thomas Proctor & Sons, Contractors, of Long Branch, New Jersey. They erected a very attractive cover for the entire plant, utilizing glass blocks over the well end and faced brick for the balance. The atmosphere of the whole plant is one of wholesomeness, gained from the clean impression created by the use of light buff brick work in the engine room, grey painted floors and a white painted well shaft. Without question, it is New Jersey's most outstanding installation of the year, the praises of which are yet to be sung by thousands who make Cape May their summer home each year.



Interior of the Monroe City, Missouri, power plant showing the new Diesel engine and generator, recently installed, in the foreground. Note Ross lube oil cooler at the base of the engine and Woodward governors on all three engines.

MONROE CITY, MISSOURI

By R. D. CAMPBELL *and* V. E. KNIGHT*

MONROE CITY passed another milestone in the growth of its municipal power plant when a new 750 hp. Worthington Diesel engine generator unit was placed in service on April 8. This unit is the fourth Diesel engine to be installed in the rapidly growing plant, and is being operated almost continuously due to the increased demand for power. Monroe City moved rapidly in the acquisition of the new unit, and in seven months' time the application to P. W. A. had been made, the bond election held, the Federal grant approved, specifications prepared, bids received, contract let, and the engine installed and in operation. The presently completed program also included a new cooling tower, the installation of a dual cooling system, the installation of 3 new cooling water pumps, the installation of a motor-generator set to replace the individual exciters formerly used, and the necessary changes in the switchboard to accommodate the new unit, as well as extensive repairs to the plant building including a complete paint job in the engine room.

Monroe City has had municipal power since 1902, when a small brick building and a 60 kw. steam engine generator unit were erected with the proceeds from a $15,000 bond issue. Much of the power supplied by the original unit was used for street lighting, and as the customer demand increased, a 90 kw. steam engine unit was added to the plant. The demand for electric power grew slowly but steadily until

*V. E. Knight, City Engineer and Supt. of Municipal Utilities, Monroe City, Missouri.

Exterior view of the power plant showing Lilie-Hoffman cooling tower recently installed to handle the increased cooling requirements.

1929 when the 2 small steam units were fast becoming inadequate. During the period from 1902 to 1929, the Diesel engine had developed from an experimental novelty into a very dependable and economical form of power.

In 1929, the city purchased its first Diesel engine which was used to augment the steam units mentioned above. The first engine was a 4 cylinder, 240 hp., Fairbanks-Morse Model 32B, running at 257 rpm. and direct-connected to a 155 kw. alternator and a 10 kw. exciter. This unit proved so successful that three more Diesel engines have been installed, and the steam equipment has been discarded and removed.

In 1934, the city obtained a grant from the Public Works Administration for $27,000, which represented 45 per cent of $60,000 of improvements being made to the power plant system. The remaining $33,000 was obtained by the sale of revenue certificates. The $60,000 derived from the grant and the sale of certificates was used to purchase 2 Diesel engines, and certain other plant improvements and extensions. The Diesel engines purchased during this expansion program were placed in service early in 1935 and, together with the earlier Diesel engine, completely replaced all of the steam equipment. The Worthington Pump and Machinery Corporation were the successful bidders and supplied two 300 hp., 327 rpm., 4 cylinder, four stroke cycle, solid injection Worthington Type D Diesel engines each direct-connected to 200 kw., 3 phase, 60 cycle, 2,400 volt Electric Machinery Company alternators and V belted to 7½ kw. exciters.

The rapid growth of the electric load is indicated by the number of hours which the various units were required to operate during 1938. A 365 day year has 8,760 hours, and here is the actual operating time of the respective units during the calendar year of 1938:

No. 1 — 155 kw. Fairbanks-Morse,
3,676.6 hrs., or 42%

No. 2 — 200 kw. Worthington,
5,875.5 hrs., or 67.1%

No. 3 — 200 kw. Worthington,
5,773.7 hrs., or 65.9%

The actual "Running Plant Capacity Factor" for 1938 was in excess of 60 per cent, indicating that the units were not allowed to remain in operation when not actually needed.

The new unit consists of a 6 cylinder, 750 hp., 327 rpm. Worthington Type EE solid injection Diesel engine direct-connected to a 521 kw. Electric Machinery Company 3 phase, 60 cycle, 2,400 v. engine type alternator. The engine is of the four stroke cycle type with cylinders of 16 in. bore and 20 in. stroke. The unit does not have an individual exciter, as did the three earlier units, but receives its excitation from the new 25 kw. General Electric motor-generator set installed during the recent expansion program.

Air for the new engine is taken in through a Burgess 12 in. Type IF air filter located atop the engine room roof. After passing through the filter, the air is conducted through a Burgess Type CA Silencer which eliminates all noise from the air inlet system. The exhaust is conducted out through a Burgess Type SDH-10 Snubber Type Silencer which effectively eliminates the exhaust noises. Silent operation is an important factor since the plant is located in the very heart of the town and on the same square as one of the hotels. This point has been handled in a most satisfactory manner.

The fuel used throughout the plant is a Refugio, Texas, topped crude, with occasional cars of Arkansas and Oklahoma gas oil being introduced. Both fuels meet the following specifications:

Cetane number, minimum	45
Viscosity at 100° F., S.S.U.	50-80
Pour Point, maximum	0° F
End Point, maximum	700° F
Gravity, A.P.I.	24-28
Sulphur, less than	.5%
B. S. & W., less than	5%

The fuel is stored in two 12,000 gallon vertical steel tanks made by the Graver Tank and Manufacturing Company of East Chicago, Indiana. The fuel unloading pump is a 1 in. Tuthill gear type pump driven by a 2 hp., 1,150 rpm., Type H Fairbanks-Morse induction type electric motor. The fuel is pumped through a piston type Worthington meter into overhead fuel day tanks located in the engine room. Each engine is equipped with fuel oil filters mounted on the engines. The newest engine has a Nugent Duplex Type Fuel Oil Filter which permits of one filter element being cleaned while the other element filters the fuel required by the engine.

Other equipment on the new engine includes a Woodward Type IC Isochronous Governor, a Ross size 809 CP Oil Cooler, Alnor thermocouples in each exhaust elbow, DPS cooling water thermometers on each cylinder, and a Cuno three-element lubricating oil filter. The engine has a pressure lubricating system for all bearings and moving parts, including the all-enclosed valve mechanism. The pistons are lubricated by a Manzel force-feed lubricator.

Starting air for all engines is supplied by two 4¼ x 2½ x 2¾ two-stage, air-cooled, Worthington type VA2HM7 compressors. One compressor is driven by V belts from a 3 hp. General Electric motor while the second is V belt driven from a single cylinder type KU 3 — 4 hp. Novo gasoline engine. There are a total of four starting air tanks grouped near the compressors.

The cooling system for the entire plant was remodeled at the time the recent engine was being installed. A second cooling tower was installed on the roof of plant office, which doubles the former cooling tower capacity. The new tower measures 9 ft. x 19 ft. x 12 ft. high and was made by the Lilie-Hoffman Company. It is rated to dissipate 1,800,000 btu. per hour with a one mile wind and a 78° F. wet bulb temperature when supplied with water at 110° F.

The plant cooling system was converted from a raw water or single system to a dual cooling system during the recent improvement program. A small basement was excavated under the engine room and two Ross CP-1208 channel two-pass type heat exchangers were installed. Space was allowed for the installation of a third heat exchanger when needed. The cooling water is handled by three 3 in. type DG16 Worthington Monobloc pumps. The pumps are powered by 7½ hp., 3,450 rpm. motors and are rated to deliver 350 gpm. at 65 feet head pressure. The three pumps are so interconnected that the middle pump may be used for either the soft or raw water circuit. As one pump is sufficient at present to handle the plant requirements of either soft or raw water, there remains one pump in reserve which may be used in either water circuit as the emergency may demand.

The cooling water system is operated in accordance with the more recent practices. The engine jacket outlet water is maintained at 130-135° F. without throttling the soft water pumps. The engines are supplied with water at temperatures of 125-130° F. The soft water temperatures are controlled by throttling the raw water pumps, or by allowing a portion of the raw water to by-pass the cooling tower and discharge directly into the tower basin.

The lubricating oil is cleaned regularly by means of a Type A Renuoil Filter having a capacity of 25 gallons per batch.

A small overhead crane is carried on rails supported from the roof trusses. This unique method of supporting the crane rails permits the use of a 16-foot span to carry the hoist in a room which is 36 feet wide. The crane is fitted with a Chisholm-Moore 1½-ton hoist and may travel the entire length of the building, thus being available to pull the pistons on any one of the 4 engines.

The last three engines installed are equipped with Woodward governors with switchboard control. An Alnor 17 point pyrometer indicates the exhaust temperature on the total 14 cylinders of the three Worthington engines. The plant is well equipped with thermometers and pressure gauges at all points. All pressure gauges in the plant are equipped with Ray Pressure Snubbers to protect the gauge mechanism from the damage incurred by continual pulsation and vibration.

The switchboard is quite typical of similar size plants, but it has one unique feature which consists of a power factor meter, with switching arrangements to indicate the power factor of each generator on the line or the power factor on any circuit leaving the plant. All feeder circuits are metered. All station power and light is metered and the M-G set is provided with its own meter. A strip chart recording watt meter records the total load. Each generator panel is equipped with a total time meter to accurately record the active operation of each unit.

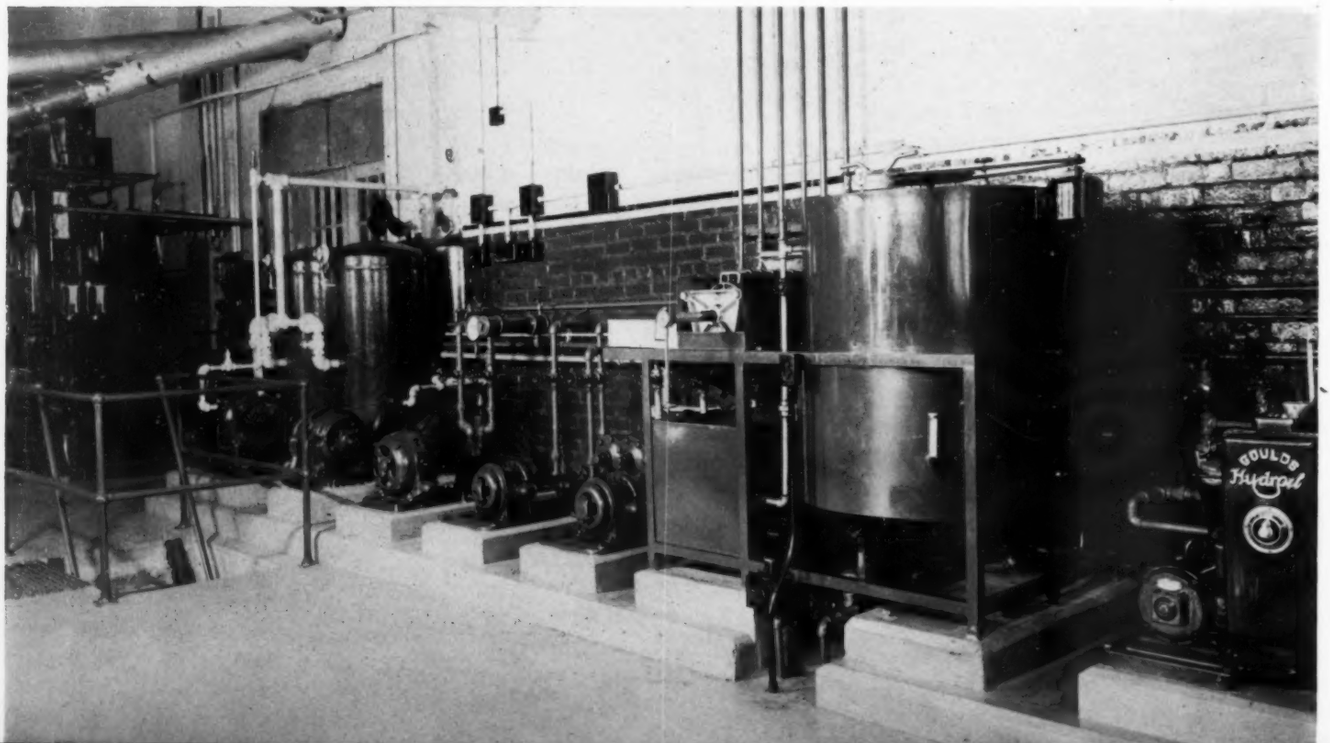
A motor-generator set has been installed to supply excitation to the entire plant. It consists of a 40 hp., 1,760 rpm., 2,300 volts type KF General Electric induction motor direct-connected to a 25 kw., 125 volt, type CD General Electric direct current generator. The new engine-generator unit was not equipped with an exciter, and all alternators now receive excitation from the motor-generator set. The three older engines were equipped with individual exciters and these will remain as emergency equipment.

All pipes in the plant are painted, using various colors to indicate the material handled within the pipes. The following color scheme is used:

Cream – Starting air; Yellow – Lubricating oil; Orange – Fuel oil; Light Green – Raw water; Dark Green – Soft water; Black – Electric conduit.

The Monroe City municipal plant serves its own corporate limits which has a population of 1,820, the villages of Hunnewell and Stoutsville which have populations of 342 and 153, respectively, and the Ralls County Rural Electric Cooperative Association which was serving 535 customers as of April 1, 1939. This last mentioned organization began operation in February, 1938, and its rapid development accounts for a major portion of the increased power demand from the Monroe plant. The Cooperative estimates that it will be serving 800 customers by August which, incidentally, happens to be the peak load month for the Monroe plant. The plant also serves a number of commercial and industrial users with relatively large power requirements. Typical of this class of customers is the city water department, the local ice plant, and a cold stor-

Auxiliaries installed in the engine room include two starting air compressors and storage bottles at the left, fuel and lube oil transfer pumps in the center, and a Goulds Hydroil lube oil reclaimer at the right.



age plant specializing in the quick freezing and storage of eggs. Each of these loads represents from 100 to 300 hp. in electric motors.

It was the rapid growth of power demand from all of the above sources which caused the council to move quickly in the acquisition of the new 750 hp. Worthington unit described above. It is of interest to note the overwhelming popularity of municipal power as evidenced by certain bond elections. Back in 1902 when it was decided to enter the field of municipal ownership, the original $15,000 bond election carried by a majority of 66 to 8, or 8¼ to 1. The election was held on the 16th of September, 1938, to approve a $50,000 bond issue for the new engine and equipment carried by 380 to 8, or 47½ to 1. Such popularity is deserved for the affairs of the city are well managed and its bonds are in good demand. The issue of $50,000 of general revenue bonds bears only 3 per cent interest and netted $50,100 after paying the costs of printing, registration, and legal opinion as to the validity of the bonds.

A brief summary of the customers, load, and revenue of the Monroe City municipal plant for the year 1938 is as follows:

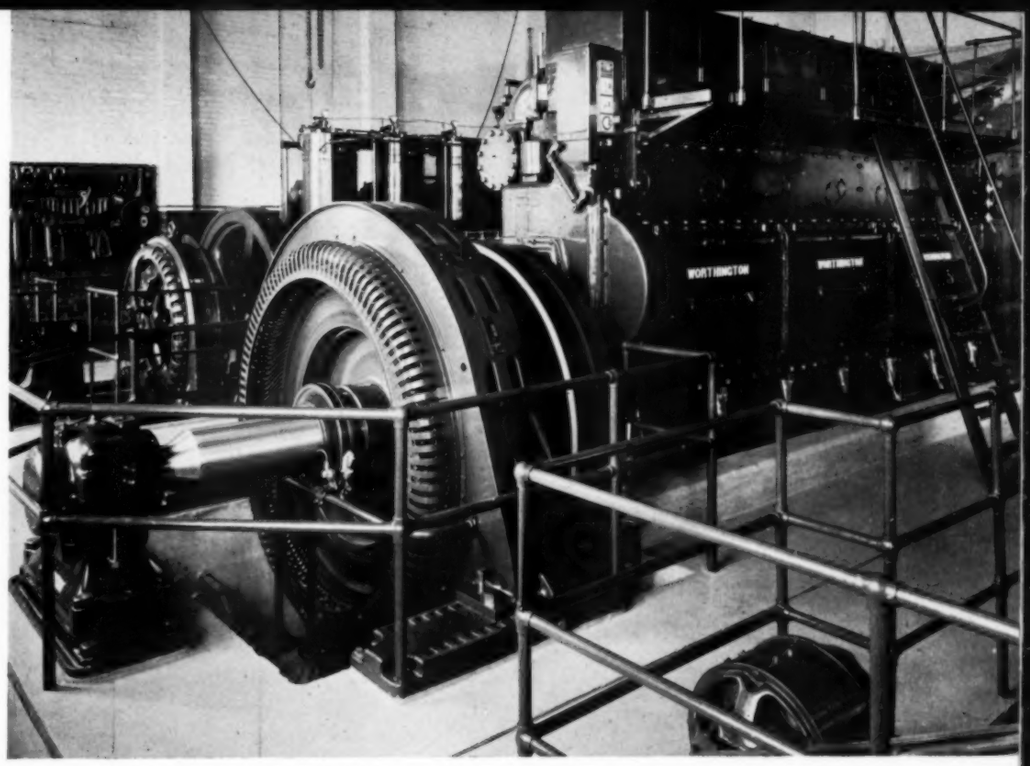
Customer Classification	*Number of Customers*	*Total Kwh.*	*Total Revenue*	*Average Price (Kwh.)*
Domestic	439	178,000	$10,225	5.75
Commercial	73	141,160	7,560	5.35
*Power and Industrial	27	629,470	12,600	2.00
Rural	15	2,700	200	7.30
**Wholesale	3	377,850	6,382	1.7
Totals and Averages	557	1,329,180	$36,967	2.78

To the above total killowatt hours of power must be added the following municipal loads in order to obtain the total power generated in 1938:

	Kwh.
Total Customer Power	1,329,180
Municipal Power	
Street Lights	63,890
Waterworks	35,320
Library and City Hall	6,000
Station Use	63,670
Line Losses and Unaccounted for	259,920
Total Generated in 1938	1,757,930

It is estimated that the plant will produce about 2,500,000 kwh. during 1939. This estimate is based on the following comparisons:

*Two largest customers qualify for and purchase their power under terms of the wholesale rate.
**Represents the R.E.A. project with 535 customers and the villages of Hunnewell and Stoutsville, all of which buy the current at wholesale rates and resell it to their customers.



View of operating side of the new Worthington Diesel engine.

Max. Kw. Demand, April 1938 325
Max. Kw. Demand, April, 1939 515
Max. Kwh. Generated During Peak Month, August, 1938 184,180
Kwh. Generated, April, 1939 204,000

It is further estimated that the peak load during the month of August 1939, may exceed 600 kw. and that the total kwh. produced for the peak month, August, will reach 250,000.

A new schedule of electric rates was put into effect as of May 1, 1938, and the effects of the new rates are being reflected in the increased use of electric energy. The current rates are as follows:

LIGHTING ONLY

First 50 kwh. @ .07 per kwh.
Next 100 kwh. @ .06 per kwh.
Next 250 kwh. @ .04 per kwh.
Minimum $1 per month

COMBINATION RATE (ONE METER)

Required when refrigerator, motors, or heating appliance are connected on meter with lights.

First 100 kwh. @ .05½ per kwh.
Next 100 kwh. @ .04½ per kwh.
Balance @ .03½ per kwh.
Minimum $2.50 per month

HEAT COMBINATION (RESIDENTIAL USE ONLY – ONE METER)

Required when an electric range or stationary water heater is connected on meter.

First 150 kwh. @ .04 per kwh.
Balance @ .03 per kwh.
Minimum $3 per month

HEAT RATE (COMMERCIAL USE ONLY)

Separate heat meter required in addition to light meter.

All kwh. @ .03 per kwh.
Minimum $2.50 per month

POWER RATE (COMMERCIAL USE ONLY)

Any heavy power not applicable to other rates. Minimum fifty cents per hp. per month of connected load in motors with charge not less than $2.

First 500 kwh. @ .04 per kwh.
Next 500 kwh. @ .03½ per kwh.
Next 1,000 kwh. @ .03 per kwh.
Balance @ .02 per kwh.

WHOLESALE POWER (75 KVA MIN.)

Minimum fifty cents for KVA of installed capacity of transformers. Customers must own transformers with meter on the primary side.

First 20,000 kwh. @ .015 per kwh.
Next 20,000 kwh. @ .013 per kwh.
Next 30,000 kwh. @ .0125 per kwh.
Balance @ .010 per kwh.

The plant reports to the Oil and Gas Power Division, Sub-Committee on Oil Engine Power Cost, of the A.S.M.E. Cost records are kept in accordance with the data required for the A.S.M.E. report, and the plant management and personnel are striving for lower oprating costs.

DE LA VERGNE CONVERTIBLE DIESELS

By WILBUR W. YOUNG

THE De La Vergne VG, 15 in. bore, 18½ in. stroke, Diesel engine was originally designed about 18 years ago as a heavy duty engine and has been improved and modified from time to time by incorporating the latest engineering and metallurgical developments. Many of these engines are in operation throughout this country and South America, in the oil fields, in electric power generating plants, and for numerous other stationary services. An increasing demand from the various fields for engines of this type to operate on natural or manufactured gas has prompted the development of the parts necessary to make this a convertible Diesel gas engine.

Converted to gas operation, this engine retains all the major parts and characteristics of the Diesel engine, and the description of the Diesel covers practically the gas engine except for modifications as follows:

(1) Combustion chamber formed by the lower part of the two piece cylinder head to be replaced by a combustion chamber having proper compression ratio for gas operation.

(2) Omitting all fuel pumps and fuel oil injection equipment.

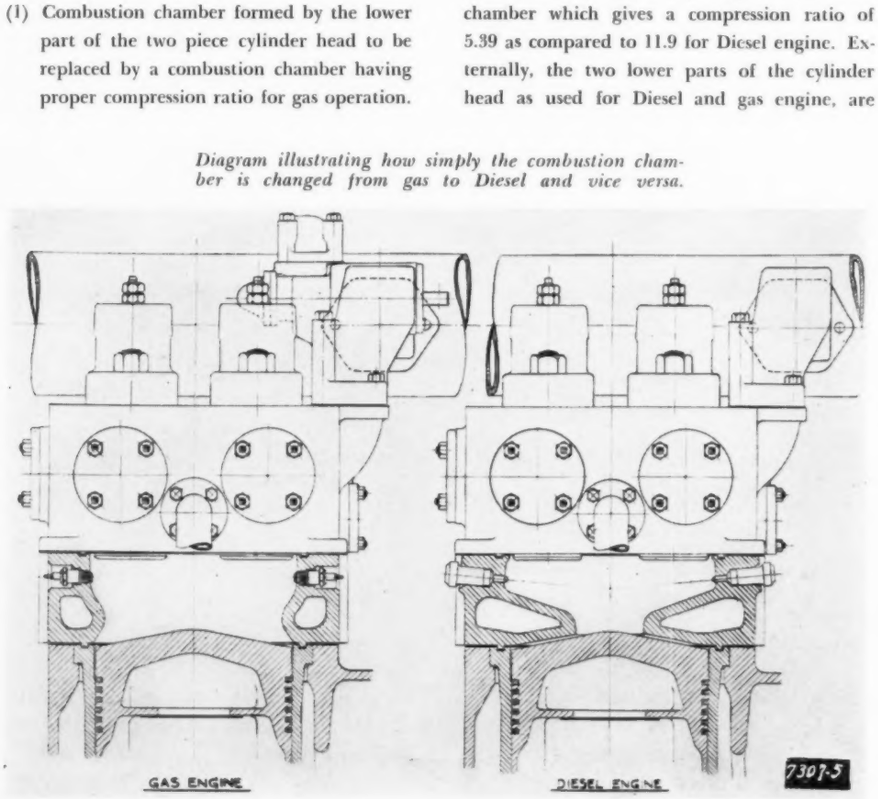
(3) Installing air gas mixing valves with governor regulating mechanism.

(4) Installing gas manifold with connection to each mixing valve.

(5) Installing of spark ignition system.

The latest two piece cylinder head construction greatly facilitates and simplifies the change over from Diesel to gas operation. The upper, principal part of the cylinder head, complete with valves and valve operating mechanism, is identical for both gas and Diesel engine. In case of the Diesel engine, the lower and smaller part of the cylinder head forms the Price combustion chamber with the two fuel injection valves. Converted to gas operation, the lower part forms an elliptically shaped combustion chamber which gives a compression ratio of 5.39 as compared to 11.9 for Diesel engine. Externally, the two lower parts of the cylinder head as used for Diesel and gas engine, are identical and all connections and circulating water passages are the same in both cases.

Diagram illustrating how simply the combustion chamber is changed from gas to Diesel and vice versa.



Exhaust valve cages are designed for water cooling. In case of Diesel operation with relatively low exhaust temperature, the water inlet and outlet to the cages may be plugged.

One mixing valve for each cylinder is mounted in, and forms part of the air intake elbow. It will readily be seen that the particular design of air intake elbow extending from the top of the cylinder head to the manifold, lends itself conveniently to the individual mixing valve arrangement permitting use of the standard Diesel air manifold without changes. A single mixing valve arrangement on the other hand would require a specially shaped air manifold to assure uniform distribution of air and gas mixture to the various power cylinders. For conversion, changing of manifolds is not necessary.

The mixing valve is of the balanced butterfly type. The air and gas valve are made integral and connected to the governor which controls the speed and prevents fluctuations by metering the proper amount of air gas mixture, corresponding to the changing load conditions. The gas valve is provided with arrangement for convenient adjustment of the gas air ratio.

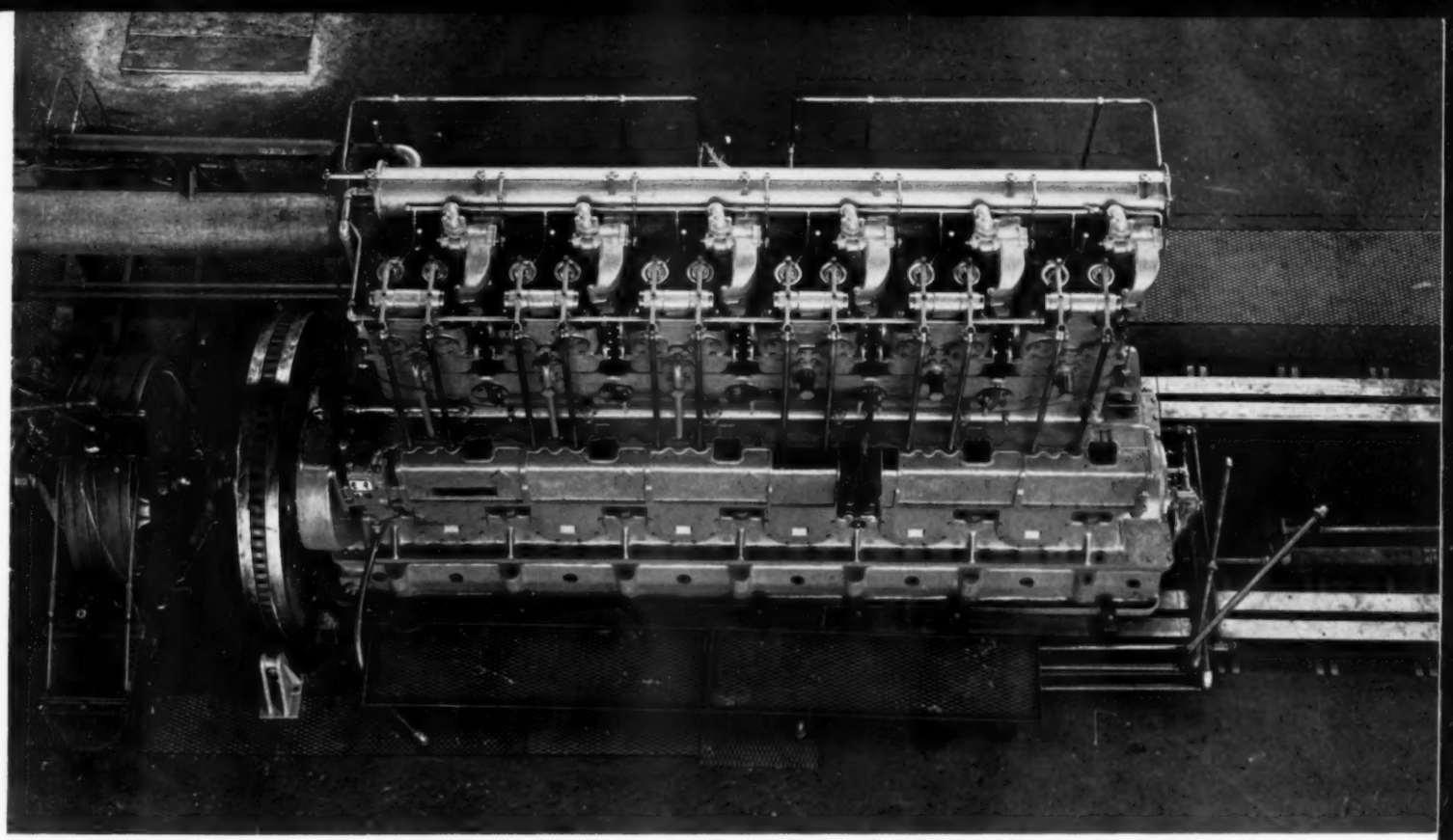
The arrangement of individual mixing valve for each cylinder has the following advantages as compared to the single mixing valve arrangement:

(1) Facilitates proper distribution of load between the cylinders.

(2) Absence of combustible mixture in the air intake manifold, eliminates difficulties from back-firing and explosions in the manifold.

(3) Better governor regulation.

The gas engine is provided with dual spark ignition system. Two high tension magnetos with built-in impulse coupling and variable timing device are geared together through a



Looking down on the De La Vergne convertible Diesel engine showing valve mechanism mechanism and individual mixing valves.

shaft which, in turn, is gear driven from the camshaft. Two heavy duty spark plugs are located 180° apart at the long axis of the elliptically shaped combustion chamber.

The six cylinder engine as described is rated 525 B.H.P. at 327 rpm. This is a very conservative rating, corresponding to 65 B.M.E.P. The fuel consumption at this load and speed is approximately 10,000 B.T.U. per B.H.P./HR. and the average exhaust temperature is 930° F.

Until recently the standard rating of this engine as a Diesel was 65 B.M.E.P., and practically all existing engines in the field can, therefore, be converted to gas operation without loss of power, without increasing piston size.

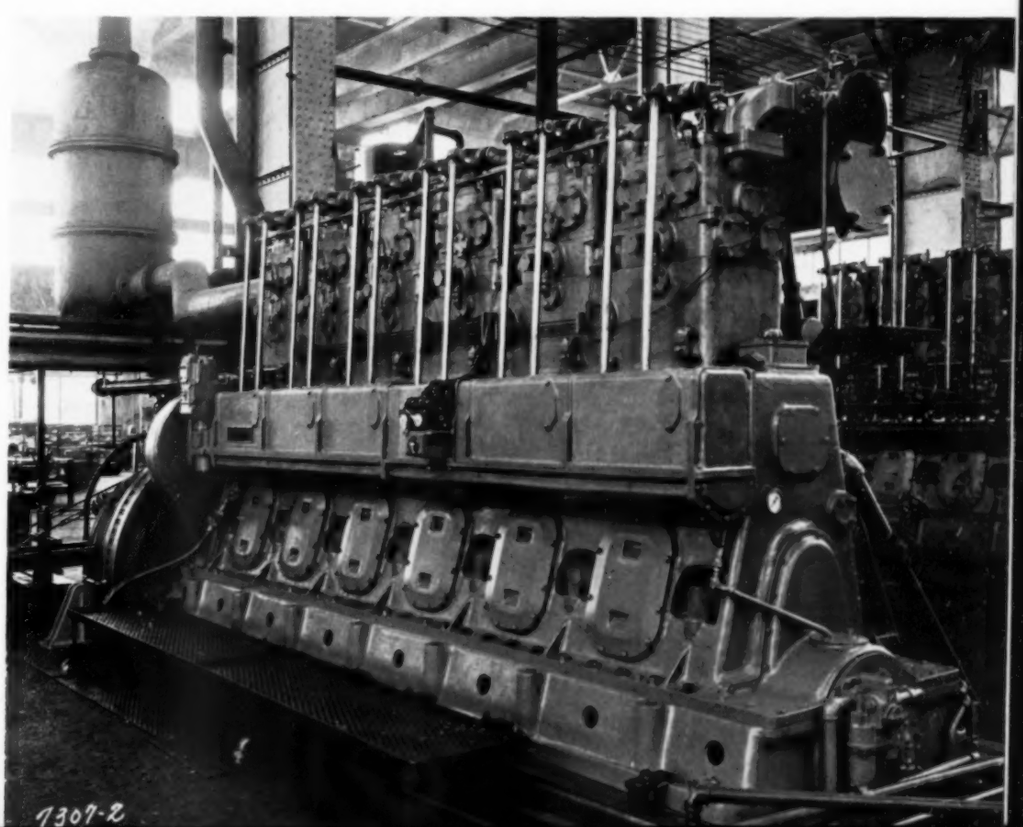
At present the Diesel engine is rated at 74 B.M.E.P. The maximum rating of the gas engine should not exceed 70 B.M.E.P., in order to avoid exhaust temperature above 1,000° F.

De La Vergne Engine Company conducted exhaustive studies with the double purpose of developing a Diesel gas conversion of sound design and of arriving at the conversion with the minimum of parts changes, time and expense to the operator.

It is seen that a workable, inexpensive gas conversion has been made available for any of the VG Diesels now in the field and that new engines of this type are available with conversion parts should the need for conversion be foreseen at the time of purchase.

Occasionally gas becomes available at or near the site of a Diesel installation. This condition occurs more frequently in the oil fields than elsewhere and there the gas supply is sometimes seasonal.

This convertible engine meets these conditions ideally since the changeover involves a few hours' time and the power output is not essentially different for Diesel or gas operation.

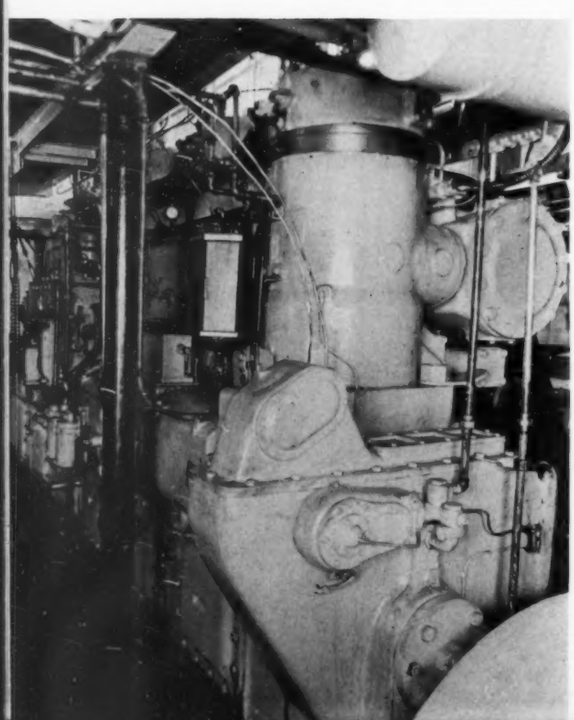


The De La Vergne VG, 15" x 18½" convertible Diesel engine on test block in their shops at Baldwin, Pennsylvania.

This new addition to Russell Brothers Towing Company's fleet is provided with the latest improvements for comfort of crew and safety in navigation.

"J. RAYMOND RUSSELL"

A Streamlined Diesel Tug



THE new tugboat *J. Raymond Russell* embodies two "firsts." It is the first Diesel tug to be streamlined and the first to be equipped with a water ballast system.

Operated by Russell Brothers Towing Company and built by Liberty Drydock, Inc., the *J. Raymond Russell* was designed for coastwise and Great Lakes service. To meet the demands for low clearance in passing through canals, the stack is squat and tear-shaped, and the deck house is low and flared. These features give the vessel a rakish appearance, not ordinarily seen in tugboats.

Engine room view showing main propulsion Diesel engine. Note Sentinel fuel oil filter in the center.

Measuring 87 feet 6 inches in length, 22 feet in width, the depth is 13 feet and normal draft 11 feet 6 inches. The water ballast system permits lightening to a draft of 10 feet.

The main propulsion engine is a Fairbanks-Morse 5-cylinder 525 hp., 2-cycle pump-scavenging Diesel. The engine is direct drive and direct reversing, and is maneuvered from a Fairbanks-Morse remote control station in the upper engine room. A 2-cylinder Fairbanks-Morse Diesel auxiliary engine drives the ship's service pump, lighting generator, and Gardner Denver engine starting air compressor.

In keeping with the general design, the engine room accessories are modern and complete. The closed fresh water cooling system is equipped with a Schutte-Koerting heat exchanger and the main engine lube oil cooler is the same make. A Goulds Hydroil is installed for lube oil reclamation. The Kelly-Smith Meeker switchboard carries an Alnor exhaust pyrometer and a Weston tachometer. Both intake and exhaust silencers are Maxim.

A Western Electric 15 watt four-channel marine telephone is installed for communication with other ships and with the shore. The transmitting and receiving facilities are housed in one compact unit with provision for "selective calling." This means that operators at shore terminals can dial the boat directly, ringing a telephone bell and thus eliminating the loudspeaker otherwise necessary to announce the call.

Directly following her completion, the *J. Raymond Russell* proceeded to Toronto and Whitby, via the Hudson River, Erie Canal to Oswego and thence through Lake Ontario, a distance of 450 miles with a barge 210 feet long, 42 feet wide and 11 feet draft, loaded with 16,500 barrels of gasoline. With this tow she made 6 miles per hour on the Hudson River, 5½ miles per hour on the Canal, and 7 miles per hour on Lake Ontario. Returning after a 36 hour layover at Toronto, she made 9 miles per hour across the lake, towing the same barge light, completing the round trip in nine days total elapsed time including the 36 hour layover. Immediately following this speedy trip, she was scheduled to Kingston with a tow of two 20,000 barrel barges. On the basis of this performance this modern Diesel tug will have no difficulty establishing her worth.

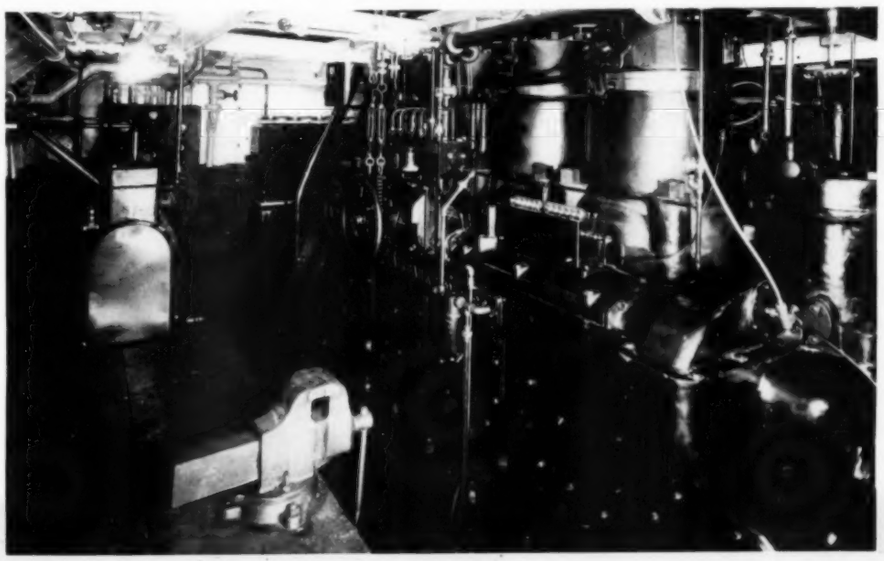
DIESEL TUG "HARVARD"

By E. SCHOONMAKER

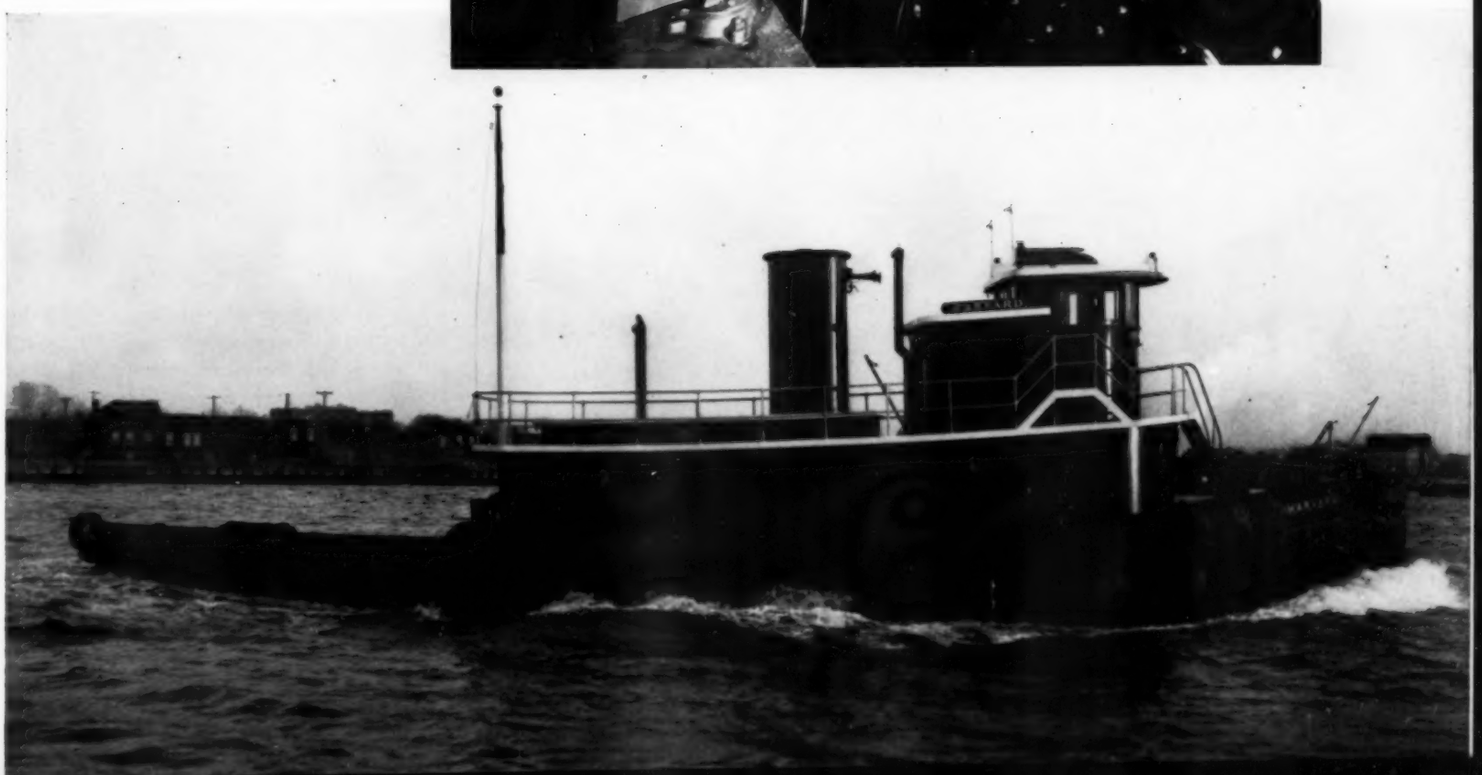
ONE of New York's most up-to-date tugs was recently put to work by the Jamaica Bay Towing Lines of Averne. Upon purchasing the tug *Harvard* from the Great Lakes Towing Company of Cleveland, she was brought to the Rockaways by her present owners, where all of its old steam machinery was removed. Completely stripped to the hull, the *Harvard* was then rebuilt under the supervision of Captain Thomas Ahlquist, its managing operator.

Measuring 71′ x 17′ x 9′, the reconditioned tugboat *Harvard* is operated by a 4-cylinder, 300 hp. 14″ x 17″ Fairbanks-Morse, 2-cycle, airless injection trunk piston type Diesel, operating at 300 rpm. As this engine is fitted with a built-in air compressor, water pump, lube oil pump, force feed lubricator, lube and oil filters and water cooled exhaust manifold, Paul Bordt of Sheepshead Bay made a very compact and orderly installation. With plenty available space left, there was no difficulty in placing the Fairbanks-Morse Diesel auxiliary, comprising a 10 hp. engine, driving a Rotary for before and after cooling, an air compressor and 2¾ kw., 36-volt generator, which is all clutch connected for operation separately, or combined, as the occasion requires. While the main engine is running, power for light is furnished by 1.5 kw, 32-volt generator, driven off the flywheel; supplemented by an Exide marine type battery for standby and peak loads. Located in the engine room, above the main engine, is an Alnor pyrometer. The engine controls, one of which is a Reliance tachometer, are located in the pilot house. The upper engine room grating is slightly higher than the top of the main engine. With the fuel tanks aft and air tanks forward, the engine room amidships is spacious and very well laid out. A dry type Maxim silencer is also installed in this boat.

In adding this boat to their fleet, the Jamaica Bay Towing Company has gone a long way toward keeping the channel open during the winter for their other tugs – the *Minnie A.* and *Chas. F. Bickle* – which are also equipped with Fairbanks-Morse 150 hp. and 180 hp. engines respectively. The *Harvard* is unquestionably one of the most up-to-date and modern tugs ever reconditioned in the Rockaways.



General engine room view tug "Harvard," showing both main and auxiliary Fairbanks-Morse Diesels equipped with Alnor pyrometer.



THE FIELD FOR AUTOMATIC DIESELS

By E. WANAMAKER*

THE inception of the Automatic individual combination Diesel-electric air conditioning, heating, lighting, and power plant should provide an avenue to improved standard of living. No one denies that, in this mechanized modern age, low cost electric current is essential and that cooling is rapidly becoming a demand second only to that of heating.

Proper air conditioning includes cooling, heating, ventilation, fresh air supply, washing, if necessary, humidity and temperature control or regulation with freedom from objectionable drafts and odors, and strictly automatic in all its phases.

Unless this is accomplished with a high degree of efficiency, the cost is excessively high – far too high for general use. As a matter of fact, air cooling has so far been accomplished only by the installation of expensive additional equipment and added expense to the other present household requirements, such as heat, light and power.

The Diesel engine as used in the automatic Diesel-electric air conditioning and electric current supply plant, as hereinafter described, offers the utmost in economy for electric current, heating, cooling, and air conditioning in all of its phases, as compared to present inefficient and complicated means of meeting these requirements.

*Office Engineer (Electrical), The Chicago, Rock Island & Pacific Railway Co.

Fundamentally the plant consists of a Diesel engine driving an electric generator, a refrigerating compressor, a heat exchanger, necessary controls for automatic operation, and such auxiliary and distribution equipment as may be essential to the purpose or purposes for which the plant is to be used.

Recently there has been developed suitable small high speed, efficient, long life, low cost, reliable automatically operated Diesel engines, polyphase motor driven, all enclosed eliminating shaft seal, Freon gas refrigerating compressors, heat exchangers, electro-mechanical controls with cadmium silver alloy contacts for controlling automatically all of the plant's component parts, polyphase generators, storage batteries, electric heating units and materials for use in the installation, which will eliminate undue service expense, objectionable vibration, noise and engine odor. Suitable fuels and lubricants are now available and service organizations are developing rapidly. This plant can be installed, utilizing existing hot air, water, and steam heating installations, producing a more economical and satisfactory service.

In considering this plant it is well to bear in mind all the factors involved which heretofore could only be met by a separate air cooling plant, a separate heating plant and an outside source of electric current supply, with necessarily high cost of installation and operation.

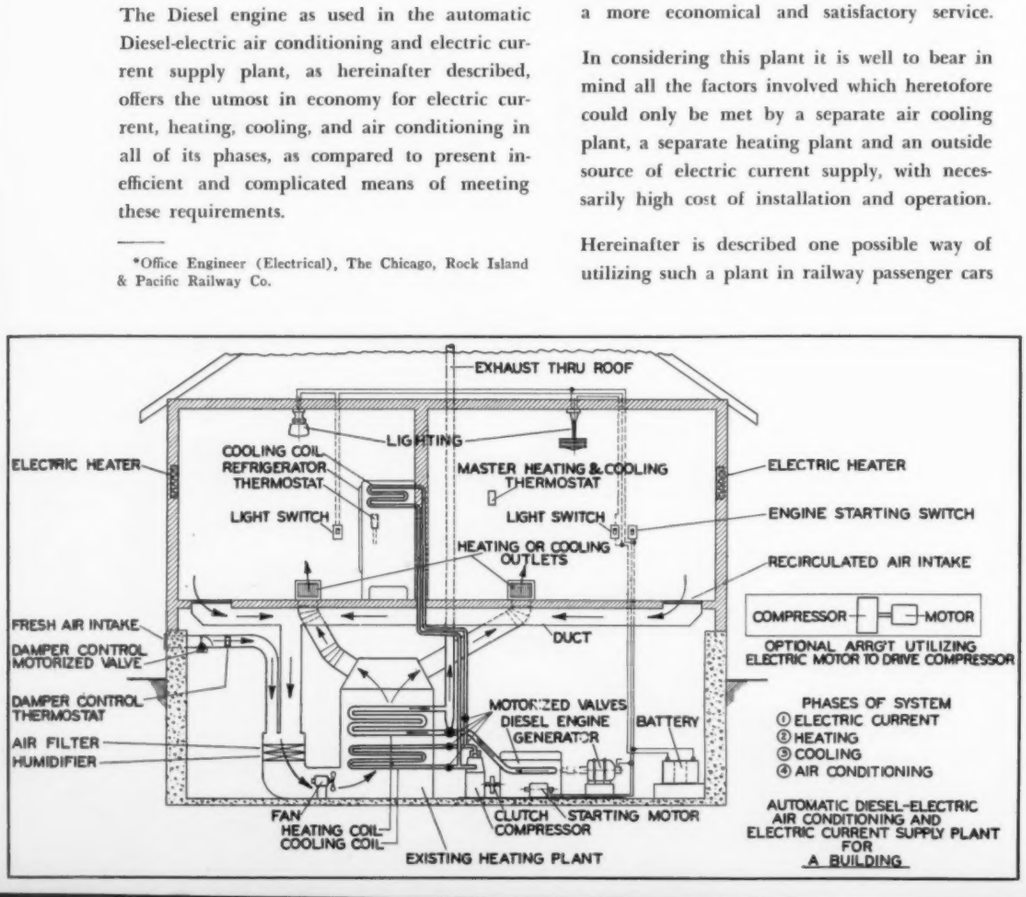
Hereinafter is described one possible way of utilizing such a plant in railway passenger cars with some suggestions as to variation in meeting the general requirements.

An installation can be made in such manner that each car is an independent, self-contained unit, in so far as heating, cooling, ventilation, humidity and temperature control and current for lighting and other purposes are concerned.

Thus a car, so equipped, may be added to, removed from, or cut in and out of any train into which it may be coupled. Also, if one of any adjacent two or more cars have an engine, generator or compressor failure, an electric trainline connector may be put up and the car electrically heated to a minimum of 40 per cent, cooling by air circulation up to 30 per cent of maximum requirements, and all lighting requirements obtained in the form of electric current from adjoining cars, or more heat if desired from two adjoining cars.

Except in cases of extreme weather conditions, the car is fully protected and under the most adverse weather conditions a degree of comfort and prevention of freeze-up is assured. When standing on sidings or in terminals, the car is self-sustaining. In general this makes for the utmost in flexibility of car service with reasonable cost, and the car is entirely independent of steam or electric current from any outside source.

Underneath the car, or in some other available space, a multicylinder approximately 40 hp. high speed Diesel engine, direct connected to a 30 kw., 220 volt, three phase, 60 cycle generator is mounted on a noise and vibration absorbing dust-proof frame housing; likewise a motor-driven Freon gas compressor – the 220 volt, three phase, 60 cycle motor mounted directly on the compressor shaft inside the compressor unit to avoid necessity for shaft gas seal and to increase efficiency with reduction in weight and elimination of vibration, all so mounted as to obtain a balanced assembly. A comparatively small storage battery, with rectifying charger, is installed for engine starting, initial control, and emergency lighting.



A welded, concentric tubular heat exchanger is installed where possible in or alongside the center sill location, connected to engine exhaust, compressor cooling line and transfer medium piping to the dual heating and cooling coils suitably located in the body of the car.

Also suitably located in the body of the car are installed electric heating units which are connected through suitable controls to the electric generator.

The dual cooling and heating coils which are actually one set of coils in which circulates the temperature transfer medium from the heat exchanger, serving a dual purpose, are together with the electric heating units all installed in connection with suitable air conveying or circulating ducts, piping, wiring, fresh air and recirculating fans and blowers; temperature transfer medium pumps, necessary dampers, controls, filters and cleaners in such manner as to cause the plant to function as follows:

If heating is called for by the control thermostats, with the main operating switch closed, the engine will start, bringing the generator up to operating voltage, current up to approximately 20 kw. will flow into the electric heating units, the remaining 10 kw. of the 30 kw. capacity being available for control, lighting, fan, pump, blower, or other circuits.

Approximately 65% of heat from the engine exhaust is utilized through the heat exchanger temperature transfer medium pipes and dual service coils thus affording ample heat capacity.

As the car warms, the automatic control gradually reduces the current flow to the electric heating units, the exhaust temperature being correspondingly reduced and adjusted until the desired predetermined car temperature is obtained, finally cutting off all heat input, at which time to prevent car temperature from rising too high from heat stored in heat exchanger piping and coils, the engine exhaust is shunted direct to atmosphere, the temperature transfer medium circulating pump stopped, cold fresh air is automatically introduced, and temperature maintained constant. The arrangement of controls may be set to obtain the most desirable method of operation.

The combination of automatic controls may be so arranged that by control of fresh air intake, fresh air circulation and recirculation air blowers, fans, temperature transfer medium pumps, exhaust control to heat exchanger and direct to atmosphere, and the electric current to electric heating units, etc., the car temperature will be maintained at any desired predetermined temperature whether or not the engine and generator are in operation to supply current for lighting or other purposes.

Automatic operation of the engine and generator for lighting or other purposes is obtained regardless of heating or cooling demands, and vice versa. If desired, when neither heating nor cooling is demanded, and but little current is required, same may be supplied from the small combination starting and emergency lighting storage battery, connected into plant with rectifier and automatic switch.

When cooling is demanded, the generator automatically supplies current to the motor driven compressor in accordance with its demand, in which case when desired or predetermined car temperature is reached, warm fresh air is drawn from outside the controls, functioning in reverse or the opposite to their function in heating operation, thus assuring a constant temperature with economic freshening of the air in the car. If desired, the controls may be set to afford a high proportion of fresh air to recirculated air at all times, since the cost factor is low, during either the cooling or heating periods. In any event no heat or cold is wasted and fresh clean air is bountifully supplied.

The combination of the plant operating controls is such that humidity is not a disturbing factor. This plant is entirely automatic in its operation as regards all air conditioning and electric current demands. However, provision can be made for such manual operation as may be found desirable.

The use of the new highly efficient fluorescent lighting now being introduced is possible with this plant, which is an important factor.

Let us consider an ordinary home in which a hot air furnace for heating has been installed. It is obvious that there are various ways in which the equipment might be installed, but will here outline only one of them.

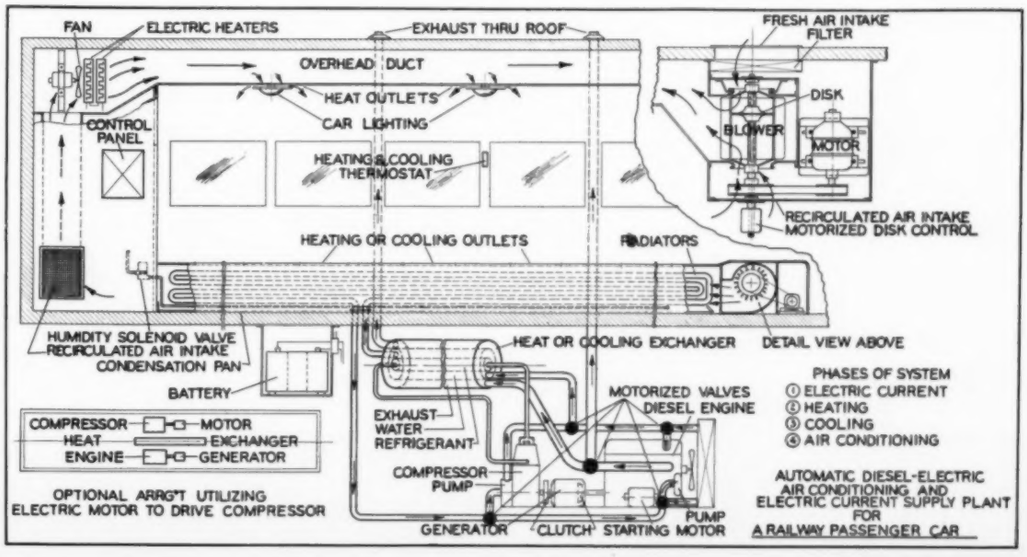
Preferably near the furnace a small plant is set up – possibly a 10 hp. engine direct-connected to a three phase, 60 cycle, 220 volt generator, for applying current to electric heating unit placed in furnace – the engine exhaust piped to a heat exchanger, also in the furnace – a Freon gas compressor – of the polyphase motor driven totally enclosed unit type with the cooling coil located in the furnace. (The compressor might be of the ordinary type driven directly by the engine through some form of automatically controlled clutch, possibly magnetic.) These three parts being so installed as to function under the direction of the automatic control, to circulate by means of blowers, dampers, etc., either warm or cold air through the distributing ducts as called for by air conditioning control thermostats.

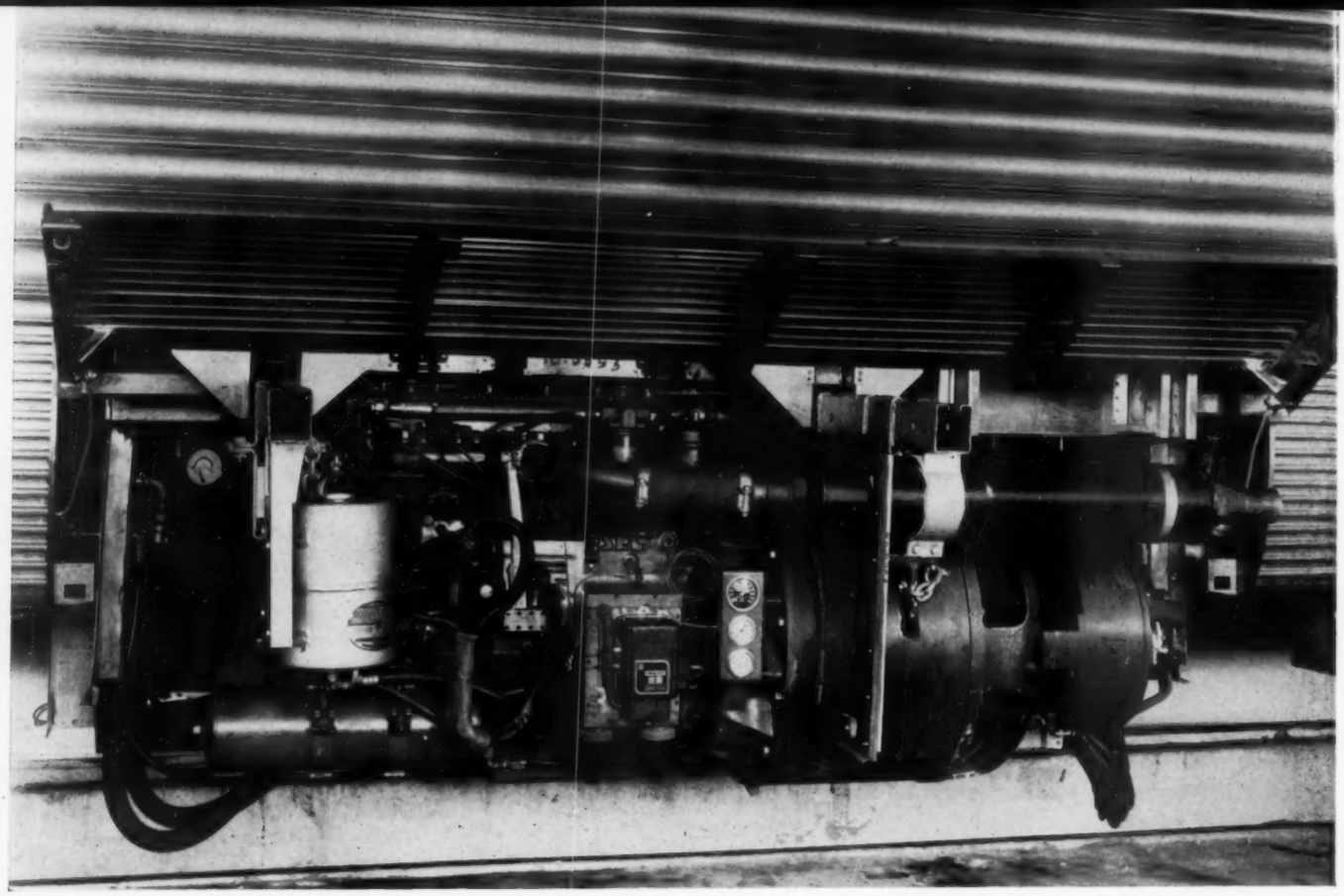
The cleaning, washing, humidity, etc., including fresh air supply and circulation as related to recirculated air, automatically controlled as outlined in the case of the passenger car, and as in the case of the passenger car, with the main operating switch closed, either the call for current, heat or cooling will cause engine to start automatically. The battery is so connected into circuit with rectifier, starter and automatic switch, that a small lighting or other current demand would be met by the battery.

The lighting through transformer may be any desired voltage. If use of electric clock is deemed essential, a small rectifier would be necessary. The 220 volts is suitable as generated for range, electric heating units and motors.

If the house be equipped with hot water or steam heating plant, the distribution piping would carry the temperature transfer medium from a double heat exchanger in the furnace – one containing the electric heating unit. In case of using present piping and radiators for temperature transfer medium, a small radiator fan could be advantageously used for air circulation.

Whenever possible the electric portion of the heat should be obtained by properly locating





A Hercules 69 hp., 6 cylinder, 1,800 rpm. Diesel engine, direct-connected to a 30 kw. General Electric AC generator, is shown mounted in a sound-deadening enclosure suspended from a sliding carriage on rubber mountings at three points. There are three of these plants, one under each passenger-carrying car of the four-car "General Pershing" Diesel electric train recently put into service by the Burlington Railroad: The first modern passenger train to be heated without the use of steam.

the electric heating units in the various rooms to be heated and cooled in conjunction with air ducts or piping for conducting the exhaust heat and coolant from the heat exchanger in exchanger box, furnace or boiler. The heating of water is incidental to the plant as a whole. In some installations where much current, heating, cooling, or any combination of same is required, the plant may be fairly large and in duplicate. In the case of plants on the farm: Current becomes cheaply available for ranges, pumps and other purposes for which electricity has long been sought.

The engine jacket water may be utilized for heating purposes if desired, or the coolant can be used for engine cooling, or any combination of both if desired, all automatic. In other words, the function of the "Universal Automatic Individual Diesel-Electric Air Conditioning and Electric Current Supply Plant" is to supply at a low cost electric current, heating, cooling, air cleaning, washing, humidity—deodorizing, control, regulation, and refrigeration, hot water, etc., in part or combination, which may be called for in railway cars, containers, boats, ships, vehicles, and buildings of all types and classes and in some industrial and manufacturing establishments.

Below is view of the trim, stainless steel, streamlined "General Pershing," the ninth zephyr of the Burlington Railroad, which now operates between St. Louis and Kansas City. This train consists of four cars and is powered with a 1,000 hp. Electro-Motive Diesel engine.

This Diesel generating set furnishes brilliant lighting and uniform power, both of which are necessary to production of fine hosiery. It saves money, too.

MORE LIGHT, BETTER HOSIERY

H. R. BAKER had three severe power problems at his hosiery mill in Ephrata, Pennsylvania, and he looked to Diesel power to solve them for him.

To manufacture full-fashioned hosiery, Mr. Baker used eighteen section leggers and twenty section footers, each machine being powered by a ½ hp. motor. In addition, adequate lighting was required for the intricate work done by his employees.

With purchased power, the commercial lines were divided into power and light, with a separate meter to measure the consumption of each type of service. Light averaged more than 6c per kilowatt, and because of this high cost, the plant was compelled to use 40 watt bulbs throughout. This was not as efficient as it should have been, due to the very fine nature of the work involved on some operations.

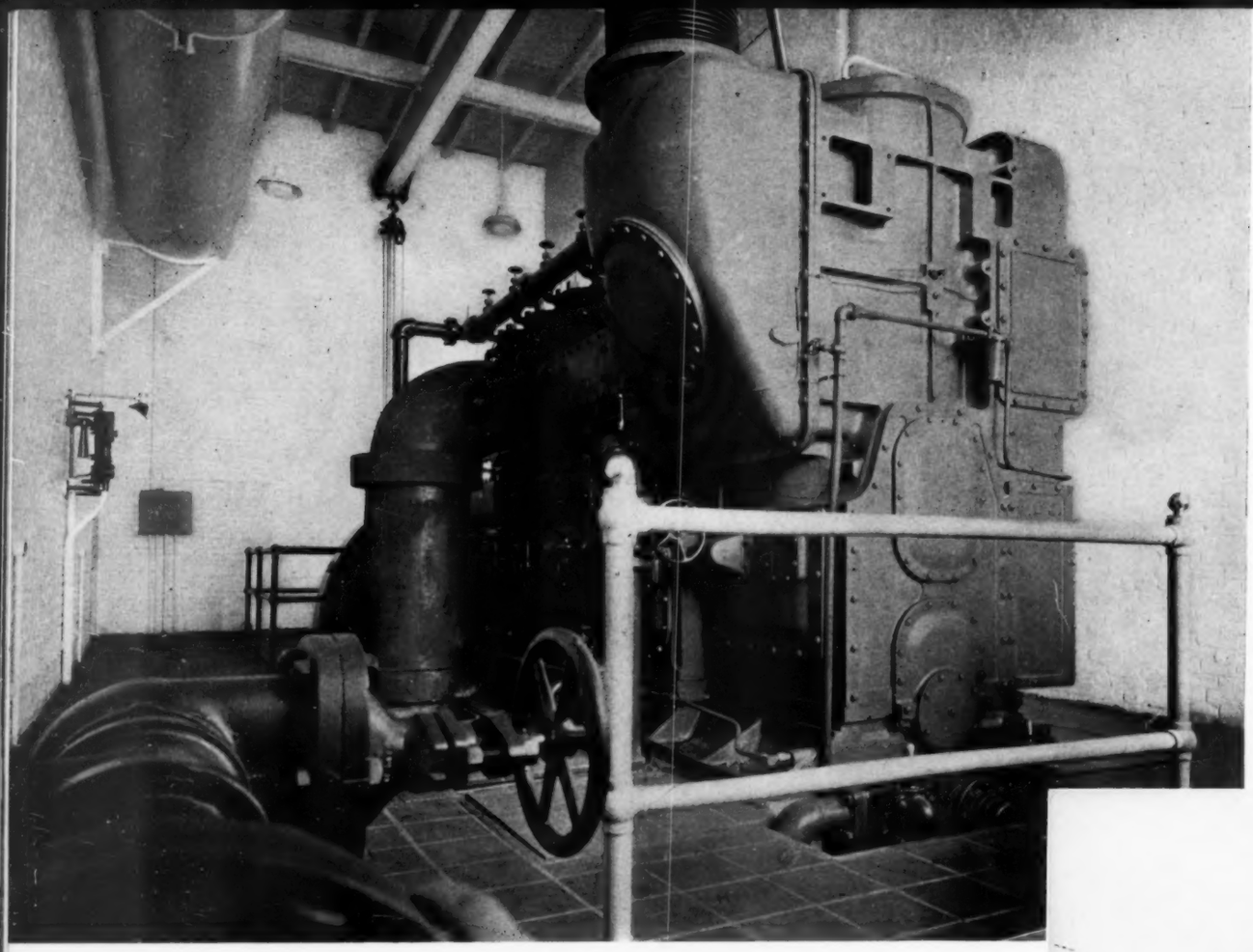
The plant is located on the outskirts of the town and, unfortunately, transformers furnishing purchased current were more than 300 feet from the plant. Due to its being practically at the end of the line, and such a distance from the transformers, service was erratic. Tests showed that on occasions machines were slowed down as much as ten per cent, because of this irregularity. Cost per kilowatt for this service ran to 2¾c.

In November last year, Mr. Baker investigated Diesel power as the solution to his problems, and convinced that a modern Diesel electric unit could supply his needs, he installed a 60 hp., three-cylinder Caterpillar Diesel engine, Vee-belting it to a Westinghouse generator. The set with a 30 kw. capacity, offered him plenty of power to take care of expansion.

Kilowatt costs immediately dropped to 1.3c. Production was, of course, upped considerably, due to the steadier flow of power, and capacity came up to a steady 180 dozen hose in a 24 hour day.

Mr. Baker immediately discarded all 40 watt light bulbs, replacing them in most cases with 60 watt globes, and in a few places with 100 watters. Efficiency was improved accordingly.

The engine operates continuously six days a week, averaging 1¾ gal. of 6½c fuel per hour.



The 1,080 hp. Alco-Sulzer Diesel engine at Marblehead is shown on the left. Note the Maxim intake silencer mounted on the engine room wall at the extreme upper left. Left — View of the Ross jacket water heat exchanger.

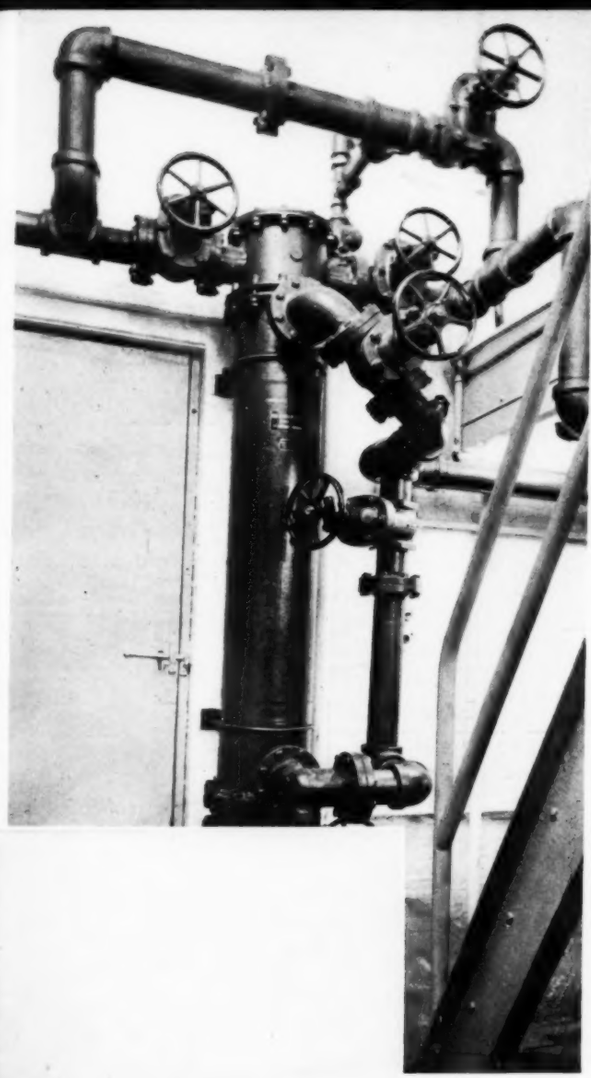
MARBLEHEAD, MASSACHUSETTS

By WILBUR W. YOUNG

HERE in this fine old New England town we find Diesel economy already established after a few months' operation. A new Alco-Sulzer Diesel engine took its place in a renovated boiler room of the municipal power plant late last year to meet the following conditions: The new engine could make no noise or vibration to disturb the exclusive neighborhood in which the plant is located. Furthermore, the engine must show economy, sufficient to justify departure from a steam program dating back forty-five years.

It should be remembered that Marblehead put its community roots down in the very beginnings of our national history. When George Washington took command of the American Army July 3, 1775, Congress was still undecided as to the expediency of fitting out armed ships. Washington, however, realized the necessity of having this equipment and he accomplished his purpose by giving army commissions to the commanders of these ships and manned the ships with detachments from his army. In other words, Washington found in his army a group of men from Marblehead who although they were soldiers, had been bred to the sea. Thus the first American warship, the schooner *Hannah*, was not only built and fitted out at Marblehead, but was manned by Marblehead citizens. The rigors of life on land and sea engendered in these early colonists a spirit of self-reliance and out of the mere accomplishment of existence, through shrewd planning and mutual effort, grew civic pride. These two characteristics were the driving forces back of the original bond issue for a municipal power plant in 1894.

The evolution of this plant is an absorbing story in itself, with a highlight occurring in 1930. At this time, two 2 stage 100 kw. turbines and the original Rice and Sargent 150 hp. simple-condensing engine were replaced by two 4 stage 600 kw. and one 4 stage 300 kw. turbine.



Basement view showing Ross lube oil cooler, Nugent fuel oil filter, and Cuno lube oil filter.

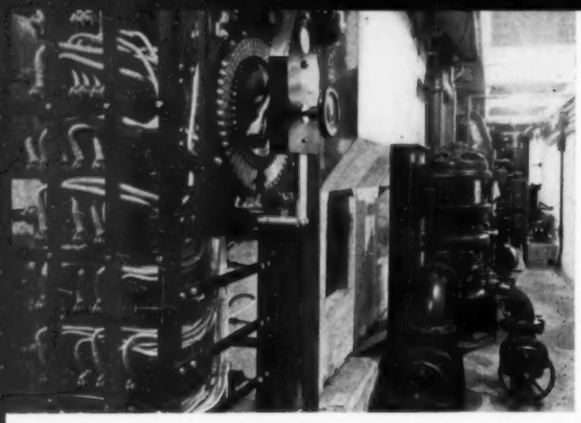
The Marblehead Light Plant on historical Marblehead Bay.

One of these turbines came from the Hudson, Massachusetts, Municipal Plant, where it gave way to a Diesel modernization program described in the December issue of DIESEL PROGRESS.

A Diesel engine was selected for the present expansion of the Marblehead plant for two interesting reasons, according to Mr. Emery Goodwin, Plant Manager. First, the citizens of the exclusive neighborhood of this plant objected to the erection of another stack which additional steam equipment would require; and, secondly, the Board, consisting of Robert W. Carey, Chairman, E. L. Homan, and T. H. Hutchinson after thorough investigation, were satisfied they could expect definite economy with Diesel equipment. Having decided, then, on a Diesel prime mover, a further set of conditions was imposed on behalf of the neighbors: There could be no noise or vibration from this installation. We shall see how these conditions were satisfied.

The equipment selected and installed in 1938 is an Alco-Sulzer Diesel, 6-cylinder 2-cycle 1,080 hp., 277 rpm., 14 in. bore x 23½ in. stroke, direct-connected to a General Electric 754 kw. 60 cycle 3 phase 2,300 v. alternator, with a belt-driven G.E. 125 v. exciter. The engine and generator concrete base is isolated from ground and building by Korfund springs. The engine is at present running on 32-70 Saybolt viscosity fuel oil which is brought from the 20,000 gal. outside storage tank by a Viking No. 2HD transfer pump direct-driven by a G.E. ¼ hp. motor. From the overhead day tank the fuel oil is heated in a Schutte & Koerting heat exchanger, using heat from a water coil around the exhaust line, then through a Nugent Size 4S filter, and through a Neptune Meter to the injection system. Injection is accomplished by individual pumps for each cylinder. The pumps are camshaft-driven and are the controlled-suction-valve type. Timing of the suction valve close is controlled by linkage from the governor which varies the start of injection with the engine load, leaving the finish of injection fixed.

Differential multiorifice fuel spray valves located in the center of the cylinder head are cooled at the tips to prevent carbon trumpet formation when using low grade fuel. Piston crowns are oil cooled through telescopic tubes connected to the lubricating system. Double-acting reciprocating pumps, driven by a crank on the end of the crankshaft, supply scavenging air. The intake valve is a sheet steel, inverted cone fitted with a fine screen in the open end, while the interior of the cone is sprayed with rubber which effectively reduces noise of the suction air.



Another basement view showing Pennsylvania vertical turbo jacket water pump.

Lube oil is Tide Water-Tycol. Reclaiming is done in a Goulds Hydroil Centrifuge, fitted with a U. S. Gauge pressure control. A Ross Heater No. 1707 heat exchanger is used for lube oil cooling and the transfer pump is a Viking, chain-driven by a G.E. motor.

Jacket cooling water is taken from the city mains and is Permutit-softened. Cooling sea water is pumped from the harbor by a 275 gpm. Penna. vertical turbo pump, driven by a Westinghouse motor, to a vertical Ross Heater No. 1206 exchanger in which the engine jacket soft water is cooled; thence through the lube oil cooler to drain back to the harbor. An emergency by-pass is provided to take city water, should the sea water intake become clogged. A Quincy air compressor, with alternate Wisconsin gas engine and Wagner Electric motor drives, maintains 300 lb. pressure on two air bottles for engine starting.

The lubricating system, piston cooling oil, and jacket water temperature alarms are U. S. gauge, as well as the scavenging air pressure gauge. A Brown distant reading exhaust pyrometer, a Woodward isochronous governor for speed and frequency regulation, a Bosch lubricator, and a National Forge & Ordnance crankshaft complete the engine equipment. Water line valves are Crane and Walworth.

As stated above, the slightest noise from this installation would be objectionable. Consequently, much thought was given to both intake and exhaust silencing. A model DO4 Maxim intake silencer is mounted on the engine room wall above and to one side of the engine, with the scavenging air intake pump directly connected to a special side outlet in the silencer. The atmospheric end of the silencer is then connected by means of a pipe up through the roof. The intake silencer, because it is inside the engine room, is protected from the weather and is accessible for inspection and cleaning, when, as, and if necessary.

Solution of the exhaust problem represents a combination of good common sense and excellent acoustical engineering. Exhaust from the engine is led through a tunnel under the basement floor to the outside wall of the engine room, where it discharges into a small concrete chamber. Above this chamber and inside a brick housing is mounted a Maxim No. 32 16-in. DO4T exhaust silencer with a short tail pipe on the upper end to carry the exhaust above the building. This silencer is described as the type offered for supercritical installations where substantially no exhaust noise can be permitted. As to the effective treatment of vibration and noise, suffice it so say that neighbors enquired when the new engine would be started, weeks after it had been put in service.

The General Electric Company gave particular study to the problem of developing special generator sine wave voltage and current characteristics which would prevent any possibility of inductive interference on telephone circuits using common poles. After consultation with the American Telephone & Telegraph Company's engineers, a maximum allowable telephone influence factor of 125 was decided upon and the General Electric Company recommended their fly-wheel type generator which has come well within one-half of the figure set up.

A recent forty-eight hour test-run produced the following fuel consumption results from this new Diesel engine:

10.7 kw. per gal. on ⅓ load
11.5 kw. per gal. on ½ load
12.8 kw. per gal. on full load
11.6 kw. per gal. average

The three major steps in the evolution of this municipal power plant are summed up in the following comparison of fuel costs:

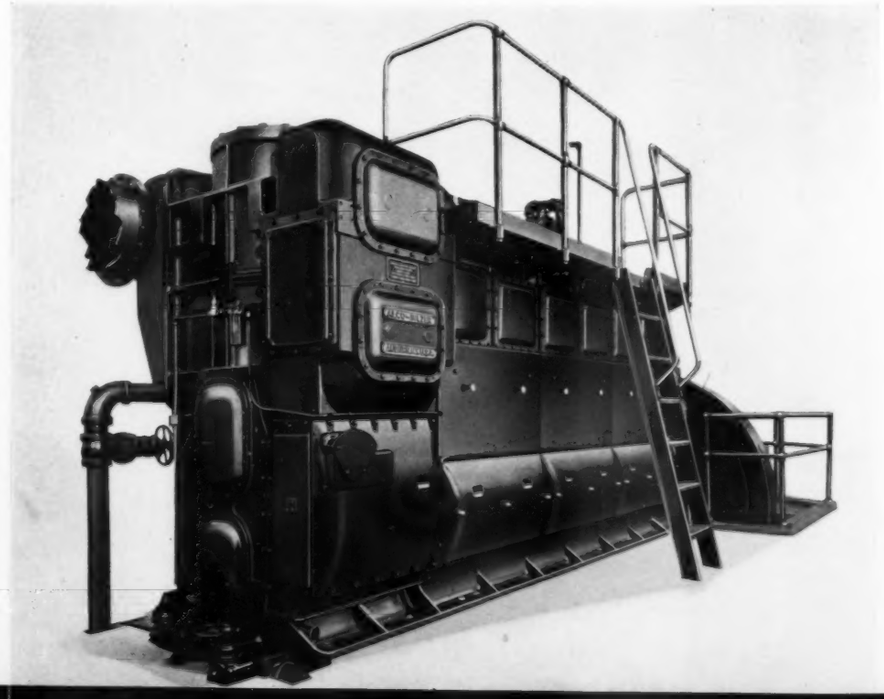
Fuel cost per kwh. old hrt. boiler basis 16 mills
Fuel cost per kwh. new 210 lb. 100° sup. steam basis 5 mills
Fuel cost per kwh. Diesel basis..... 3¾ mills

The plant equipment, as it now stands, includes three turbines, one of which has been rebladed to operate on 210 lb. steam superheated 125° from an oil fired water tube boiler. It is planned to reblade the other two turbines for high pressure steam this year and to cut them all in on one boiler. Thus the steam plant has a total capacity of 1,500 kw., which, combined with 754 kw. from the Diesel plant, gives a total generating capacity of 2,254 kw. with optimum flexibility.

This arrangement ties in satisfactorily with an existing contract for purchased power with the Lynn Gas & Electric Co., providing that not more than 1,500,000 kwhr. can be generated by the Marblehead plant each year. A nice balance is, therefore, worked out whereby utility current is kept on the line at all times with the steam plant and purchased power handling winter peak loads and the Diesel plant combined with the utility taking the summer peaks.

It was not easy for the citizens of Marblehead to reach a decision authorizing departure from their long-established method of motive power From all present accounts, however, the operating personnel and citizenry are well satisfied that the new Diesel engine is delivering the results expected. In fact, there is evident enthusiasm over this addition to the power plant.

Shop view of the Alco-Sulzer Diesel engine taken from the scavenging pump end.



NAVAL ACADEMY CRUISING YAWLS

By WILL H. FULLERTON

THE increasing attention that the Navy Department is giving toward instruction of modern seamanship to the Midshipmen of the Naval Academy has resulted in the acquisition at Annapolis of quite a fleet of small boats. These will supplement their sailing cutters, which are merely large overgrown rowboats with old fashioned rigs and which need a spanking breeze to make them move and handle with any liveliness.

The Academy possesses quite a fleet of small International 14 ft. sailing dinghies and the appetite for deep-sea cruising has been whetted by the acquisition of the well-known "wishbone" schooner *Yamarie*, in which the midshipmen have already essayed their ability as contestants in the races to Bermuda.

So that instruction of this character will be available to a greater number of the student body, the department recently called for the submittal of designs and prices from the leading architects and builders on the Atlantic Coast for a 30 ft. seagoing auxiliary Diesel cruising yawl to be built to conform to the rules of the Cruising Club of America. It was stipulated that the boat be 44 ft. overall, 33 ft. waterline, 11 ft. beam, 6 ft. draft, with 23,400 lbs. displacement and an area of working sails of 878 sq. ft., yawl rig and an ample supply of light sails. As a result of the invitation, the designs of the Luders Marine Construction Company of Stamford, Conn., were selected and that firm awarded the contract to build three of these boats, work on which has already been started.

The boats are of the cabin trunk type with a bridge deck and a watertight cockpit. Steering is done with a wheel instead of a tiller. Accommodation is afforded for a crew of eight. The general accommodation, while somewhat simpler in detail, follows in general the usual yacht practice in modern boats of this type. There is a convenient up-to-date galley with cook stove, ice box, dresser, and sink located alongside the main companionway and at that portion of the boat which will have the least motion and permit serving a hot stimulant under almost any reasonable condition.

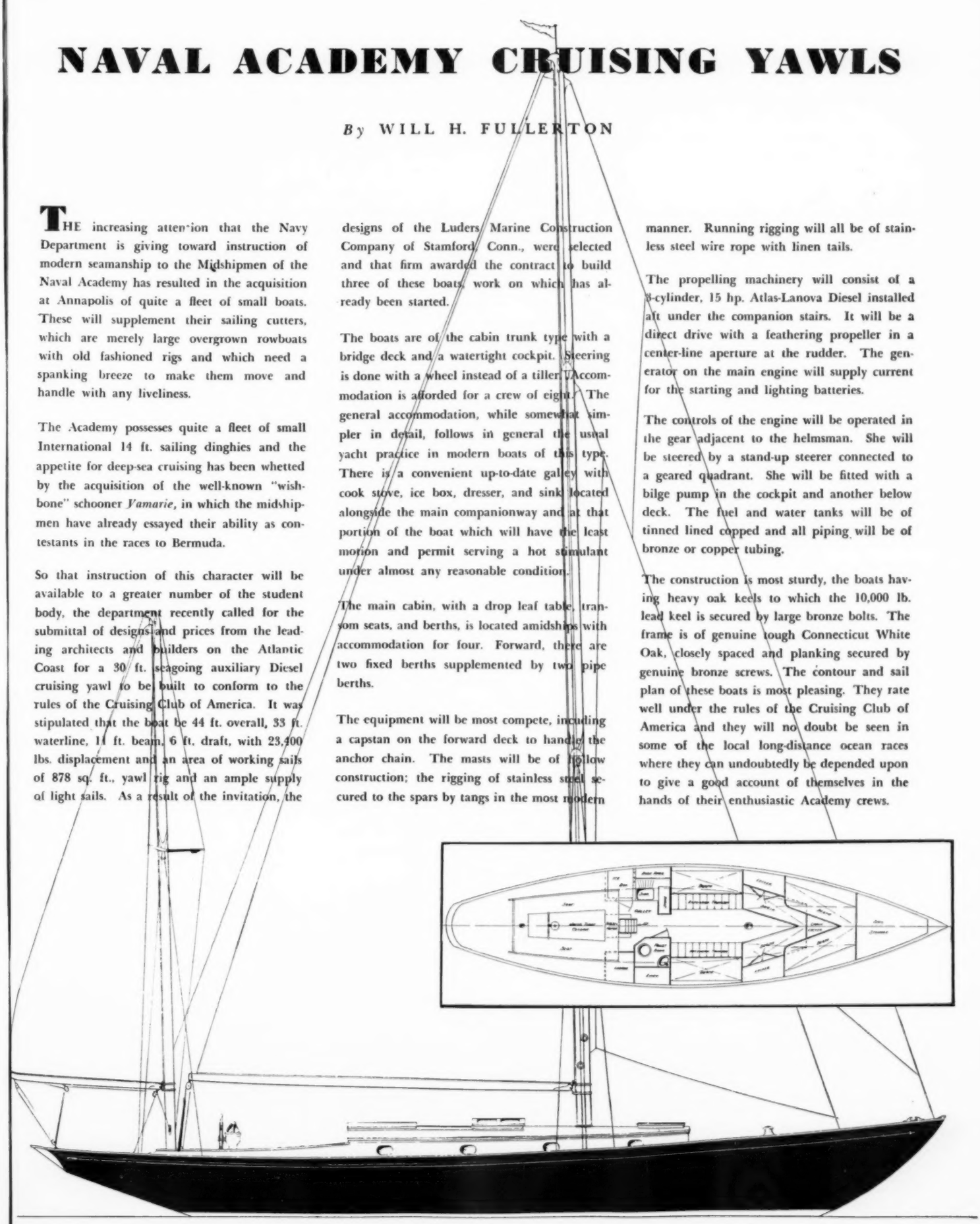
The main cabin, with a drop leaf table, transom seats, and berths, is located amidships with accommodation for four. Forward, there are two fixed berths supplemented by two pipe berths.

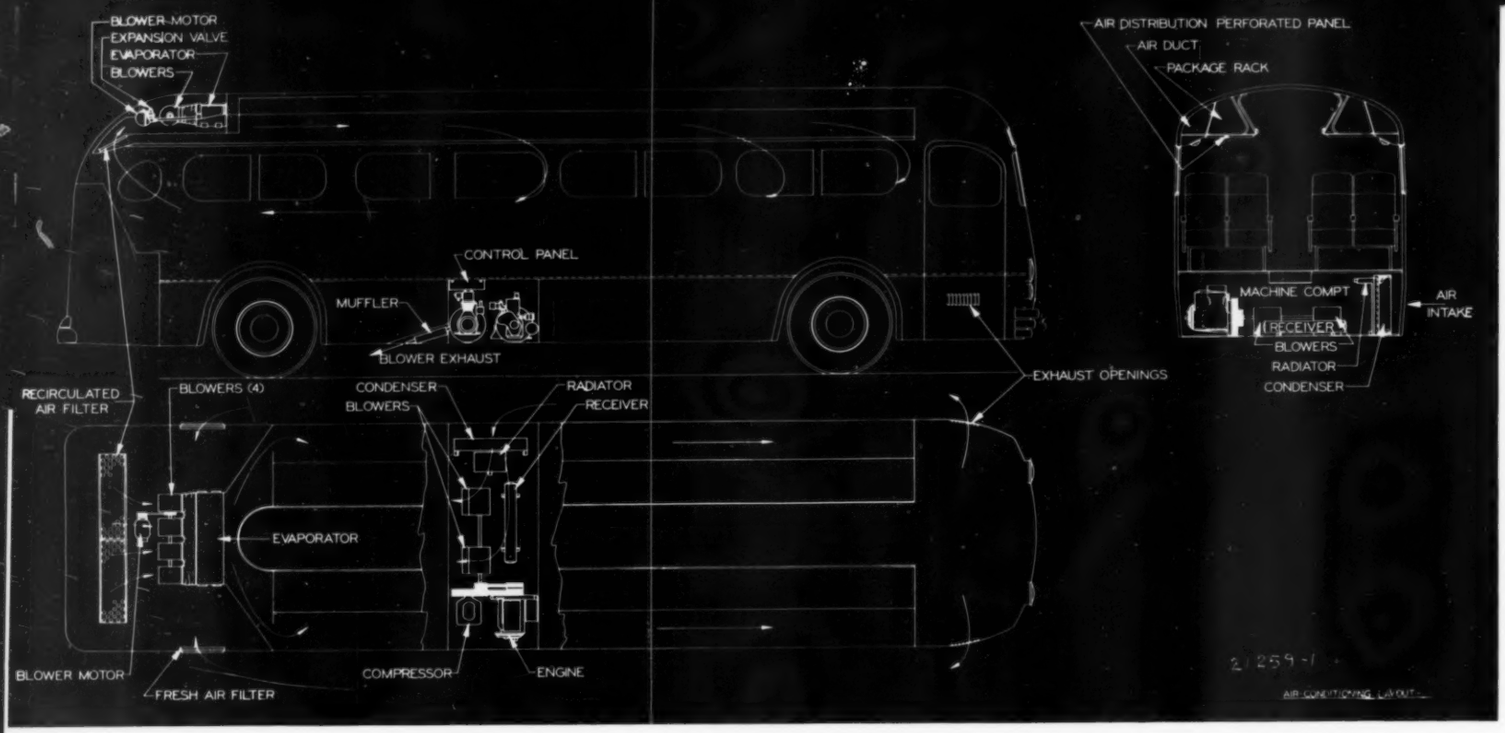
The equipment will be most compete, including a capstan on the forward deck to handle the anchor chain. The masts will be of hollow construction; the rigging of stainless steel secured to the spars by tangs in the most modern manner. Running rigging will all be of stainless steel wire rope with linen tails.

The propelling machinery will consist of a 3-cylinder, 15 hp. Atlas-Lanova Diesel installed aft under the companion stairs. It will be a direct drive with a feathering propeller in a center-line aperture at the rudder. The generator on the main engine will supply current for the starting and lighting batteries.

The controls of the engine will be operated in the gear adjacent to the helmsman. She will be steered by a stand-up steerer connected to a geared quadrant. She will be fitted with a bilge pump in the cockpit and another below deck. The fuel and water tanks will be of tinned lined copped and all piping will be of bronze or copper tubing.

The construction is most sturdy, the boats having heavy oak keels to which the 10,000 lb. lead keel is secured by large bronze bolts. The frame is of genuine tough Connecticut White Oak, closely spaced and planking secured by genuine bronze screws. The contour and sail plan of these boats is most pleasing. They rate well under the rules of the Cruising Club of America and they will no doubt be seen in some of the local long-distance ocean races where they can undoubtedly be depended upon to give a good account of themselves in the hands of their enthusiastic Academy crews.





Plan view of air-conditioning installation on Burlington Trailways' new Diesel buses.

AIR-CONDITIONED BUSES

By GEORGE D. CROSSLEY

THE Burlington Transportation Company recently put into service "Dieseliners," representing a new development in modern buses. These are on a daily transcontinental service between San Francisco and New York and mark the first use of Diesel engines in Coast-to-Coast bus travel. This fleet consists of twenty-one yellow coaches powered with 2-cycle, 6-cylinder General Motors Diesel engines, and each coach is designed to accommodate twenty-eight passengers with all the comforts of a Club Car.

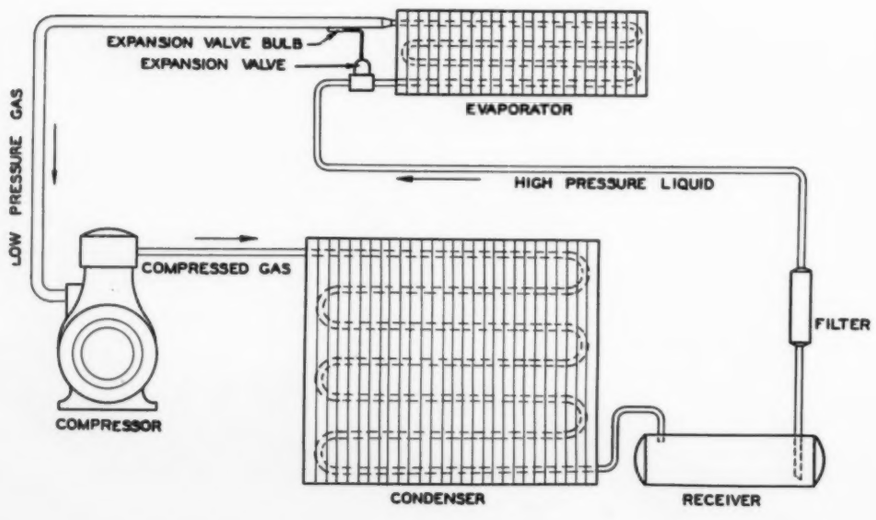
Air-Conditioning units used in these coaches are the development of Yellow Coach engineers working in conjunction with Frigidaire. The result is a compact unit, which increases weight of coach approximately 1,200 pounds, the lightest installation now available. A small engine and the refrigerating units are mounted under the floor and in the rear of the roof. Air circulates through ducts built into the coach. More than 1,200 cubic feet of air is introduced throughout the coach per minute, all of which has been automatically filtered, cooled or warmed as operating conditions require, holding a temperature of from 73° to 77° and the relative humidity from 40 to 50 per cent. To the left of the driver is the control box which permits an accurate, automatic thermostatic control of both humidity and temperature for the comfort of passengers in every weather condition in the United States. Windows are of double glass, locked in position, protecting against dust, dirt, and outside temperatures. The roof and walls of the coach are completely insulated, permitting the air-conditioning unit to operate at its fullest efficiency at all times.

Here's how this most advanced air-conditioning system operates:

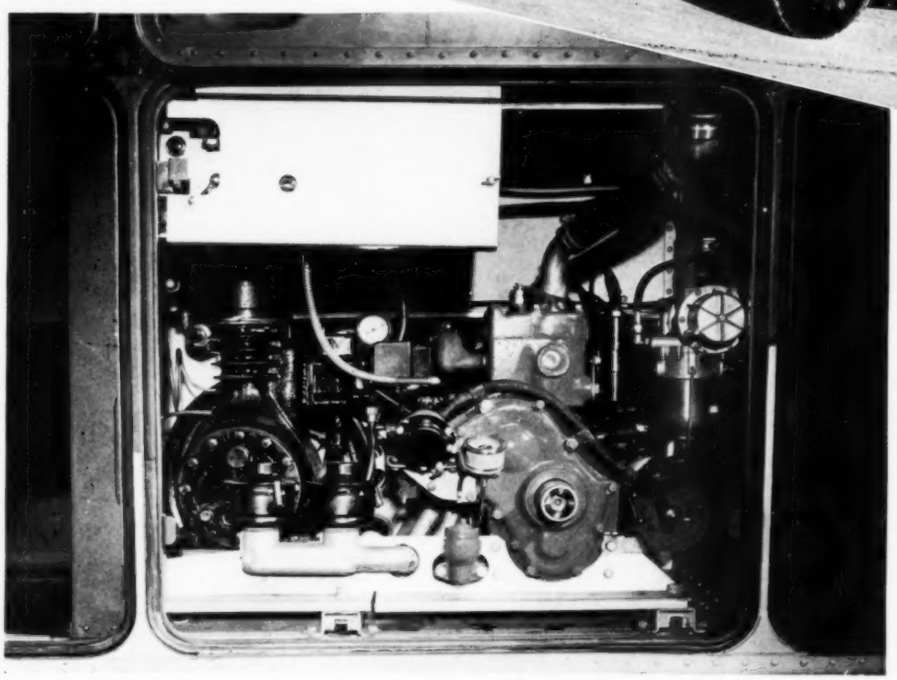
1. – A motor driven compressor which compresses Freon refrigerant. The motor is a four-cylinder, 61 cu. in. engine capable of developing 14.5 hp. at 1,800 rpm. Only about 70 per cent of this power is used. The engine operates normally at 1,800 but is modulated to 1,200 according to cooling requirements.

2. – Condenser. – Hot gas from the compressor passes into a dry type condenser where it is cooled and liquefied. The compressor is a simple two-cylinder vertical reciprocating machine of 2½ bore and 3⅛ stroke operated normally at 800 rpm. and modulated to 533. Machine consists of flywheel, crankshaft, crankshaft seal, connecting rods, pistons, cylinder head and feather valve plate assembly. Compressor is self-lubricating and requires no attention.

3. – Expansion valve. – The high pressure liquid after passing the filter enters an expansion valve which meters refrigerant into the evaporator at the proper rate. Expansion valve bulb operates on the thermostatic principle



REFRIGERATION SYSTEM



Exterior view of Burlington Trailways' Diesel bus and close up of air-conditioning power plant installed as indicated by plan on opposite page.

automatically adjusting the valve orifice according to the suction line temperature.

4. — Evaporator. — This part of the unit with blowers and filters is located in the ceiling at the rear of the coach. The high pressure liquid after passing the expansion valve, enters the evaporator core where expansion takes place resulting in a drop in temperature. Recirculated air and fresh air passing through the filters is thoroughly cleaned of dust, pollen, smoke, odors, etc., and is picked up by the blowers and passed through the coils and fins of the evaporator, where it is cooled and passed into longitudinal ducts and is distributed throughout the coach evenly to all seats. As a result of the expansion which takes place in the evaporator, the pressure of the gas is reduced and is piped in low pressure state to the intake side of the motor-driven compressor. This completes the cooling cycle.

5. — Controls. — Cooling thermostat located in recirculated air stream starts, changes speed of, and stops air-conditioning engine. Two sets of cooling thermostats are provided so that two minimum temperatures are available. When cooling is required engine starts automatically and runs at 1,800 rpm., producing four "tons" of refrigeration until inside temperature of coach is reduced to 77° or 73°, depending upon whether high or low cooling position has been selected on the master switch, to the left of the driver. Modulator solenoid mounted on air-conditioning unit engine and controlled by cooling thermostat, then partially closes throttle, so that engine runs at 1,200 rpm. If inside heat is great enough, temperature will slowly rise until it reaches 77° or 73° when engine speed returns to 1,800. However, if temperature continues to drop, when it reaches 75° or 71° engine will stop. It will start again when temperature has risen to 77° or 73°.

Some advantages of Yellow Coach air-conditioning system are: Light in weight. — Entire weight, including all air intake fixtures, built-in ducts, special insulation, etc., increases coach weight but approximately 1,200 pounds. Parts requiring attention are easily accessible, it not being necessary to roll out unit merely to check water or oil. Provides proper temperature reduction whether outside air is humid or dry. No large quantity of water is required. A dry condenser is used because it is simpler, lighter and more reliable. This eliminates troublesome water pumps; clogging of spray nozzles; the 50 to 60 gallons of water which must be replenished every few hours; rusting caused by water. The weight saving factor is of great importance as 50 to 60 gallons of water weigh 415 to 500 lbs., with an additional weight of 75 to 120 lbs. for tanks.

Front view of Rock Port, Missouri, Municipal lighting plant.

ROCK PORT, MISSOURI

By BENNETT B. SMITH

ROCK PORT'S first light plant was erected in 1892 when a bond issue of $6,000 was voted for its construction. This plant was in operation until 1908 when it was sold to the Rock Port Light & Power Company for $5,000, payment to be made at $100 per month, without interest. In 1916, the equipment was sold to the Tarkio Electric & Water Company which ran lines to Rock Port, at which time the old local plant was closed. This company was later purchased by the Missouri Service Company who furnished electricity from their plants at Tarkio and Mound City until last year, when the new municipal plant was put into service.

The new Municipal Light Plant at Rock Port, Missouri, has been in operation since August of last year and each day the people of the community realize that they have invested in a proposition well worth while. Naturally, there were those who discouraged the idea of a municipal plant but these are fast being won over to the idea of its being a wise investment. Previously, electricity had been furnished by a corporation which was giving good service at a reasonable rate. The town, however, was interested in the revenue being kept at home.

Rock Port, a town of 1,162 people located in the extreme northwest corner of Missouri, voted $90,000 in bonds for construction of the new plant, after many months' discussion. This amount was augmented by a PWA grant of $47,250. As construction progressed, it was found more money would be needed and a second PWA grant of $6,050 was secured, for a total of $53,300.

Work on the plant started January 1, 1937, and it was necessary to start from the very beginning with the construction of a building, the installation of machinery, and the rebuilding of the whole distribution system. A proposition to buy the corporation's lines was refused.

Three Anderson, Model 38, Diesel units were installed in the plant, each with a capacity of

240 hp. at a total cost of $106,710. The units have operated efficiently and only one lengthy shut-down has occurred when the plant was off forty-five minutes. This occurred, soon after the plant began operation, when a leaky water line in the cooling system caused this comparatively long lapse of service. Over each engine a three-ton Yale-Towne block hoist has been erected to facilitate handling the large sections when repairs are necessary. The generators for these engines were supplied by Electric Machinery Corporation of Minneapolis.

Goulds Hydroil centrifuges are used to supply the engines, while McCord equipment for lubrication is used. A Marley coil is installed in the closed-type cooling system to which is attached four Goulds pumps. Coils for circulating jacket water from the engines have been placed in the fuel oil tanks to heat the oil should a heavier grade of fuel oil be used at any future time which would require additional heat.

A small, 6-volt generating equipment was installed as an emergency lighting system for use in the plant in case of failure of the regular units. A type M, Allis-Chalmers switchboard with Westinghouse instruments also have been installed.

The town expects to have the plant completely paid for within a twelve year period from the income of the plant. In fifteen years, their plans are to be free of any city tax, the plant being expected to take care of all city expense.

The rate now charged for residence use has not been reduced from the old high line rate but business houses received an approximate 20 per cent reduction. Rates for residences at present are 9 cents for the first 35 kilowatt hours which is then reduced to 4 cents for next 65 kw., 2½ cents for above 100. Power rates start at 7½ cents for the first 50 kilowatts and and then is reduced to 5½ cents for next 50, 4 cents up to 1,000, 3 cents above 1,000. Minimum monthly charge is $1.00 for residence.

The plant will take care of the new Rural Electrification Project of 370 miles through Holt and Atchison counties, for which a Federal grant has just been allowed. Rock Port has had the contract to supply this electricity for sometime. The plant building was newly constructed of brick and is 50′ x 75′ with a built-up roof of cork and tar. Window frames are of steel and the whole structure is absolutely fireproof. Showers and toilets are a part of the equipment. In building the new structure, the fact of additional equipment was kept in mind and the south wall was made of temporary construction so that it may be removed and the building enlarged. This will be necessary should another generating unit be added to take care of this new business. Work on the REA is expected to start soon.

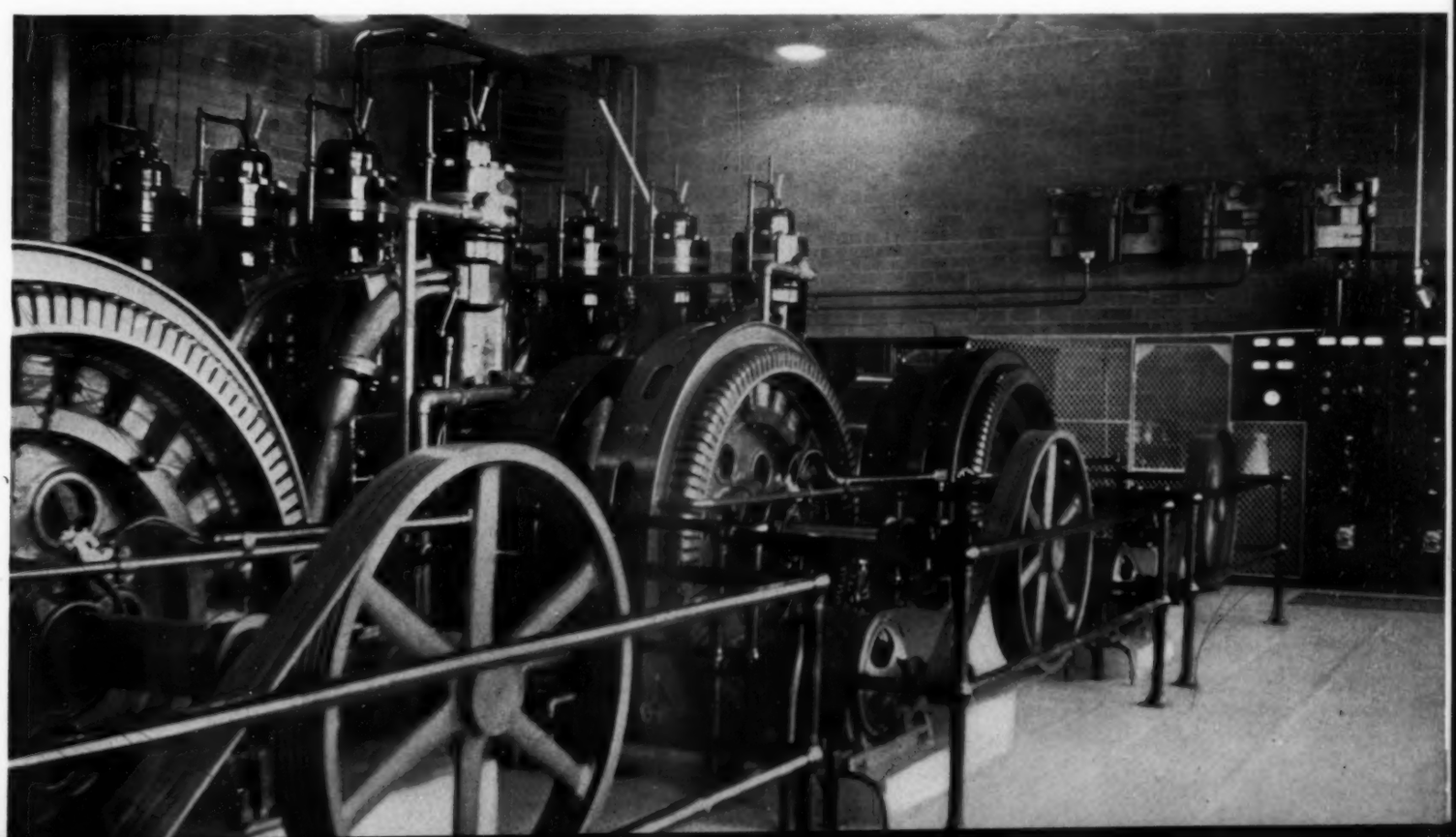
General Electric meters are furnished by the city. Property owners are required to deposit $5.00 for each meter used in rental or other property. No interest is paid on these deposits.

A complete system of keeping records has been devised, for figures are kept in large groups and are further broken down into hourly readings. Records show, however, that in a recent month 64,200 kilowatts were generated, 55,290 of which went on the line while the others were used in the plant or lost. This generation was at the rate of 926 kilowatts per gallon of fuel oil. The daily average output is 2,000 kilowatts. Century motors and Goulds pumps are used for pumping the oil.

The city has a rather unusual system of charging themselves: The light plant is under the control of a Board of Public Works composed of four men appointed by the Mayor and approved by the City Council. The terms of office of these men are so arranged that only one man's time expires each year and then a new man appointed. The water plant is also controlled by the B.P.W. The City Council pays the power plant for street lighting. The water plant pays for its power taken from the power plant, and the power plant pays the water plant for water used.

The General Superintendent is Harry L. Kennedy, who is assisted by J. J. Miller, Chief Engineer, C. S. Roberts, and W. P. Walker, operators. C. L. Hartman is Water Superintendent.

General view of engine room showing the three Anderson Model 38, 240 hp. Diesel engines, together with the Electric Machinery Corporation generators, and a portion of the control panel in the background.



One of fourteen Cummins Diesel trucks bringing 14 tons of "muck" up a 16 per cent grade out of New York's new Midtown Tunnel to save two months' working time and $100,000 in cost of construction.

DIESELS IN MIDTOWN TUNNEL

Diesels Can Build Tunnels But Not Use Them

By OTIS A. SIBLEY

ALTHOUGH Diesel trucks and buses are forbidden the use of the new Lincoln Tunnel, which connects New York City and New Jersey, because of so-called objections to exhaust gas, Diesel trucks are actively engaged in the construction of the new Midtown Tunnel on the opposite side of Manhattan. The facts underlying such an obvious inconsistency will be of unusual interest to everyone who is hampered by discriminatory regulation against low-cost Diesel hauling. Briefly, this contradictory situation occurred as follows:

One of the principal problems in tunnel building is efficient and economical handling of "muck," or mud, dirt, shale and rock, which is blasted loose and which must be removed continuously so that the drilling and blasting can proceed without interruption. This function is usually performed by electric locomotives and trains of dump cars, which is a slow and costly procedure since track must be laid, extra labor employed to handle the cars and, worst of all, the material must be transferred to trucks at the portal which necessitates an extra loading operation. Obviously, substantial savings in time and money are possible by loading "muck" in the tunnel directly onto the trucks which carry it to its final destination. One obstacle, faced the contractors for the Midtown Tunnel: The New York State Department of Labor forbids the use of internal combustion engines in tunnel work because of the carbon monoxide in the exhaust gases *except by special permission which had never been granted previous to this job*. Because the potential savings were so great, it was decided to investigate various types of en-

Interior views of the tunnel showing the type of working conditions imposed upon the first motor trucks ever to be approved for such service by the New York State Department of Labor. Cummins Diesels were responsible for this exception to the previously unbroken rule. The Carbon Monoxide Indicator is shown above during an actual test.

gines and their exhaust characteristics in the hope of finding one which would satisfy the Labor Department's restrictions. Chief Engineer Feldblet first discovered that Diesel engine exhaust gas, unlike that of gasoline engines, was almost entirely free from dangerous carbon monoxide. With this encouraging start, he obtained complete exhaust analyses and reports of Diesel operation in mines and tunnels abroad and in other states where they have been used successfully, although frequently without official sanction. He finally concluded that Cummins Diesel-powered trucks would satisfy the restrictions imposed and presented his case to the authorities.

After reviewing his data and reports of official tests conducted in the tunnel on a Cummins Diesel, officials of both the Labor Department and the New York Tunnel Authority approved their use, the former in writing and the latter verbally. Arrangements were made immediately with the Andrew Gull Corporation, sub-contractors for cartage and hauling, to replace the gasoline engines in ten of their eleven trucks with Cummins Diesels. One other unit was already so equipped.

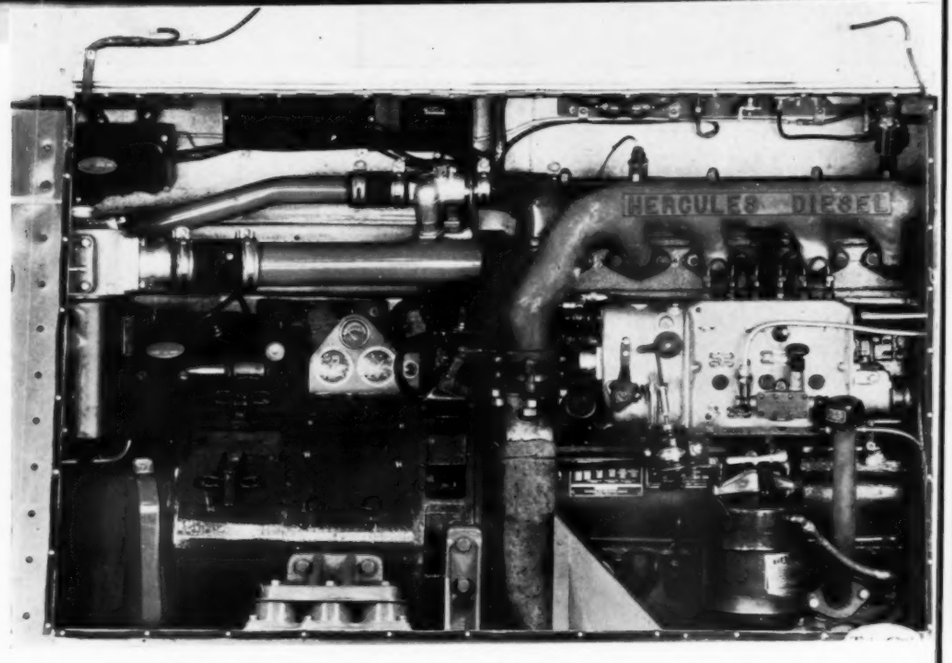
During the time necessary for obtaining permission to use Diesels and making conversions on the trucks, the pilot tunnels were completed and the stage set for drilling the main shafts. Work then progressed so rapidly that extra trucks were hired and an average of fourteen plus a Diesel-powered shovel follow closely behind the drillers to keep the tunnel free of "muck." The trucks carry approximately six yards each or 14 tons per trip and work 24 hours per day moving as many as 110 loads on each eight-hour shift compared with 60 or 70 loads which is the maximum to be obtained with electric dump cars. To say that all concerned are pleased with the record of the Diesel trucks is an understatement since it is anticipated that they will save between 40 and 60 days' working time and approximately $100,000.00 in cost of construction. The sub-contractor reports substantial reductions in operating and maintenance charges.

The work in the Midtown Tunnel provides a severe test for the Cummins Diesels. Each truck with its 14-ton load must climb a 600-ft. 16 per cent grade from the tunnel to the street. Halfway up the ramp is a sharp V turn which necessitates stopping and backing to negotiate. Thus, the second half of the grade must be taken from a standing start. In the tunnel the Diesels have exceeded all requirements as to purity of exhaust. Tests are made daily with a Carbon Monoxide Indicator covering both exhaust gas and blasting fumes and the results are reported to the Department of Labor. The maximum concentration of carbon monoxide allowed is 0.03 and the highest reading obtained to date is 0.01 which was recorded immediately following a blast when the trucks were not in the tunnel. With the trucks in the hole and no blasting immediately before the test the Indicator seldom varys from the 0.005 mark which is 84 per cent better than required for satisfactory working conditions. Since the human system requires many times the amount of air during hard labor than when relaxed and ventilation of a completed tunnel is at least as good, if not better, than one under construction, it would seem that barring Diesel-powered vehicles from the use of tunnels is an arbitrary discrimination. Especially since it has been proved that gasoline engine exhausts contain a much higher percentage of carbon monoxide.

Here is one more outstanding case history of Diesel economy and dependability to be added to the thousands already recorded on the pages of DIESEL PROGRESS. Almost without exception the world's tough jobs, whatever they may be, can be handled quicker, cheaper and safer with Diesel engines. Compared with other available types of power the Diesel will soon pay for itself out of operating and maintenance cost differential. Its many other exclusive advantages easily account for its remarkable acceptance in every industry and trade.

NEW YORK DIESEL BUSES

By WILL H. FULLERTON



The Hercules Diesel-electric installation on Twin Coach buses operated by Surface Transportation System in New York City.

THE Surface Transportation System, one of the large bus operators in Greater New York, was the first to use Diesel engines in buses in New York City. The Surface Transportation System purchased the first trial unit early in 1937 and it proved so successful that in May, 1939, an additional order for twenty units was placed with the Twin Coach Company, followed by two additional orders of twenty units each, making a total of sixty-one Diesel electric buses purchased by this operator.

These coaches operate on the heavily-travelled Third Avenue route, with approximately ten stops per mile, and average slightly in excess of four miles to the gallon of fuel used, replacing, of course, gasoline mechanical coaches. The unit illustrated above is of a forty passenged capacity, mounted on a wheelbase of 239 inches. The body and under-structure are of all-metal construction, riveted and assembled together in a single unit, eliminating the conventional chassis.

The propulsion equipment consists of a Twin Coach-Hercules Diesel engine, 6 cylinder, bore 4⅜", stroke 5¼", displacement 474 cu. in., rated at 125 hp. at 1200 rpm., with a maximum torque of 340 ft. lbs. at 1200 rpm. Directly connected to the engine is an electrical generator which, in turn, feeds electricity to the electrical propulsion motor located underneath the floor ahead of and connected to the rear axle by means of the conventional drive shaft. The electrical drive eliminates the mechanical clutch and transmission, which materially reduces the manual effort required to operate the coach and provides exceptionally smooth acceleration due to the elimination of gear shifting.

The Surface Transportation Company is one of the larger Utilities studying Diesel electric equipped motor vehicles by the practical application of them to their various routes. The success which they have encountered with the Diesel electrics to date has been impressive and is being closely watched by other transportation companies.

Latest Diesel Patents

A description of the outstanding patented inventions on Diesel and Diesel accessories as they are granted by the United States Patent Office. This information will be found a handy reference for inventors, engineers, designers and production men in establishing the dates of record, as well as describing the important Diesel inventions.

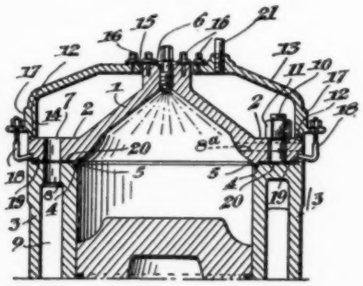
Conducted by C. CALVERT HINES*

2,154,358

CYLINDER HEAD CONSTRUCTION FOR DIESEL ENGINES

William Hope Ross, Estevan, Saskatchewan, Canada

Application February 9, 1937, Serial No. 124,881
1 Claim. (Cl. 123 – 173)



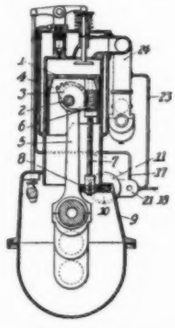
A cylinder head construction comprising in combination a cylinder wall, a conical head member of substantially uniform thickness having a fuel injection valve opening at its apex and an integral depending annular flange at its base, abutting the upper surface of the cylinder wall, a cover fitting over said head member to form a water chamber and having an opening for the apex of said head member, means for detachably securing the cover to the flange of the head member and means for detachably securing the flange to the cylinder wall.

2,153,691

INTERNAL COMBUSTION ENGINE AUTOMATIC COMPRESSION RATIO VARYING MEANS

Yasusaburo Hironaka, Tsuwano-cho, Kanoashigun, Japan, assignor of one-half to Kenjiro Tsuneda, Kyoto, Japan

Application April 13, 1936, Serial No. 74,210
1 Claim. (Cl. 123 – 48)



An internal combustion engine, comprising a servo-motor mechanism for varying the compression ratio in the engine cylinder, means responsive to and controlled by the explosion gas pressure for actuating said servo-motor, a double acting valve controlling the admission to said servo-motor of the explosion gas coming from the engine on one hand, and controlling the discharge of said explosion gas on the other hand, a vacuum cylinder connected at its one end to the intake pipe of the engine, and open to the atmosphere at the other end, a vacuum piston in said vacuum cylinder and connected for operating said double acting valve, and a weak spring normally acting upon said vacuum piston against the action of said vacuum, the arrangement being such that the controlling valve is opened to permit the admission of the explosion gas to said servo-motor as the vacuum approaches atmospheric pressure to decrease the compression, and is closed to permit discharge of said explosion gas from said servo-motor in reversed condition to increase the compression in the engine cylinder.

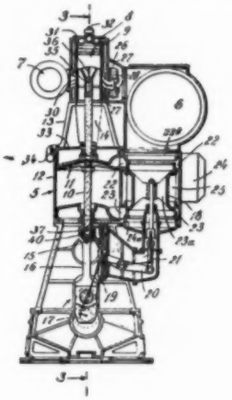
*Patent Attorney, Washington Loan & Trust Building, Washington, D. C.

2,155,068

INTERNAL COMBUSTION ENGINE APPARATUS

Heinrich Walti, Winterthur, Switzerland, assignor to Sulzer Freres, Societe Anonyme, Winterthur, Switzerland.

Application September 22, 1936, Serial No. 101,894. In Switzerland, October 1, 1935.
3 Claims. (Cl. 123 – 57)



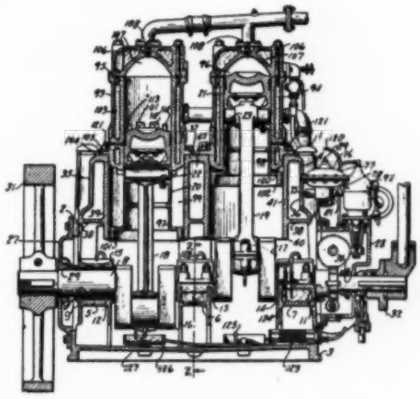
1. In combination, an internal combustion-engine plant including at least one principal combustion engine of the type requiring scavenging or charging air, and a separate auxiliary air compressor unit supplying said air for said principal combustion engine, said auxiliary unit comprising at least one engine-driven compressor including an engine cylinder, an engine piston, a piston rod, a connecting rod, a crank, an air pump cylinder arranged between said engine cylinder and said crank and an air pump piston arranged in said pump cylinder on said piston rod between said engine piston and said connecting rod, a spider securing said engine cylinder to said pump cylinder in such manner that said engine piston is exposed between said cylinders, whereby to allow inspection of said engine piston during operation and to prevent pollution of said air, and an air conduit directly connecting said principal combustion engine and said air compressor unit to convey said scavenging or charging air.

2,154,504

INTERNAL COMBUSTION ENGINE

Samuel B. Gold and Bruce E. Gold, Independence, Mo., assignors to Weber Engine Company, Kansas City, Mo., a corporation of Iowa

Application November 4, 1936, Serial No. 109,116
3 Claims. (Cl. 123 – 59)



1. An internal combustion engine including combustion chambers having intake ports in the sides of the chambers and having exhaust ports at the opposite sides thereof, charging chambers having intake and discharge ports, a transfer reservoir providing a common connection between the discharge ports of the charging chambers and all of the intake ports of the combustion chambers, pistons reciprocal in the combustion chambers and movable over the intake and exhaust ports of said combustion chambers, valves in the discharge ports of the charging chambers automatically operable responsive to differential pressures in the transfer reservoir and charging chambers, means in the charging chambers for drawing a charging medium into said chambers through the intake ports thereof and discharging said medium through said pressure responsive valves for transfer to the combustion chambers when the pistons uncover the intake ports to effect scavenging of exhaust gases through the exhaust ports of said combustion chambers and effecting charging of the combustion chambers, and valves controlling the intake ports of the charging chambers, the intake ports of the combustion chambers being of different capacities and arranged so that certain of said intake ports of the combustion chambers are uncovered by the respective pistons in advance of opening of the other intake ports whereby the portion of the charging medium admitted from the transfer reservoir through the first opened ports is caused to move upwardly along the sides of the combustion chambers and the portion of the charging medium admitted from the transfer reservoir through the second opened ports is caused to flow under that admitted through the first opened ports to maintain movement of the medium to the upper end of the combustion chambers during the time said exhaust ports are opened by the pistons.

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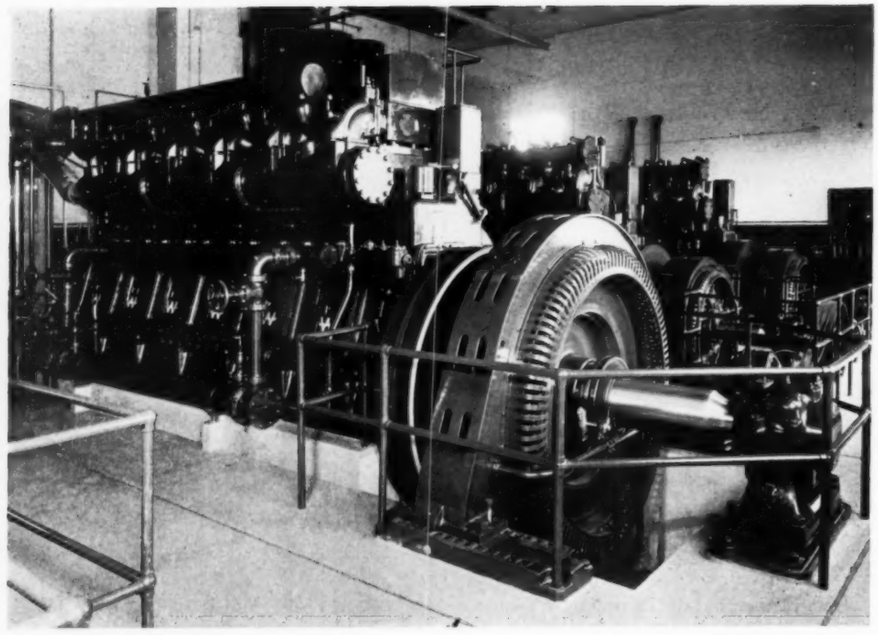

ANTICIPATION PROVED PROFITABLE!

IN 1935, the Monroe City, Mo., Municipal Plant installed the first two Worthington Diesels, each being 300 hp. 4 cylinder.

These engines were equipped with an Alnor Model R B pyrometer to keep a close check of the exhaust temperatures of each cylinder. While an 8-pt. switch would have been ample they decided to use the 17-pt. for reserve capacity.

In 1938, when the demand for power had increased to such an extent that additional capacity was necessary, a third Worthington Diesel was installed, this being a 6 cylinder 750 hp. unit. Because of the foresight in having an Alnor Pyrometer with reserve switch capacity, it was only necessary to purchase the additional thermo couples for this new engine.

Alnor Exhaust Pyrometers always offer the most for the investment for any Diesel Engine. They offer a still greater saving for the growing plant when an instrument with reserve switch capacity is installed.

Alnor Exhaust Pyrometers can now be furnished in switch capacities of from 2 to 36 points in a single instrument.

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423 NORTH LaSALLE STREET • CHICAGO, ILLINOIS

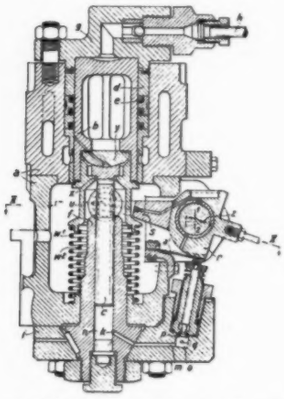
"Alnor Pyrometers"—The ENGINE X-Ray

2,155,098

FUEL INJECTING DEVICE FOR INTERNAL COMBUSTION ENGINES

Karl Mohr, Kiel, Germany, assignor to Fried. Krupp Germaniawerft Aktiengesellschaft, Kiel-Gaarden, Germany

Application February 2, 1937, Serial No. 123,583. In Germany February 7, 1936
5 Claims. (Cl. 103 — 50)



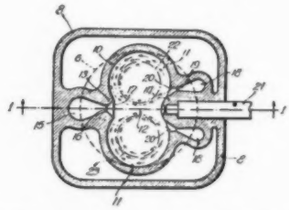
1. In a fuel injecting device for internal combustion engines, a freely movable differential piston comprising a large end and a small end, said ends being relatively movable, cylinders for the respective ends of said piston, means forming a fuel inlet conduit to the cylinder space in which the small end of said piston operates, a fuel inlet valve controlling said conduit, and a pivoted control member for said valve comprising a lever arm linked to the large end of said differential piston.

2,157,658

INJECTION ENGINE

Hans Fischer, Yonkers, N. Y., assignor to Lanova Corporation, New York, N. Y., a corporation of Delaware

Application July 22, 1937, Serial No. 155,032
7 Claims. (Cl. 123 — 32)



1. In an injection engine, a cylinder and a piston operating therein, a combustion chamber opening into said cylinder, a primary supplementary chamber opening into said combustion chamber at one side thereof through a restricted orifice and a passage leading therefrom flaring inward of said combustion chamber, an injection nozzle having a port at the opposite side of said combustion chamber disposed to inject fuel toward and into said passage and into said primary chamber in amount to form therein a quick burning fuel-air mixture causing creation of relatively high pressure within said primary chamber incident to combustion therein and resultant ejection therefrom of a high pressure high velocity blast through said passage into said combustion chamber and a secondary supplementary chamber opening into said combustion chamber at said opposite side thereof through a restricted orifice and a passage leading therefrom flaring inward of said combustion chamber and substantially opposed to and in the path of travel of the blast ejected from said

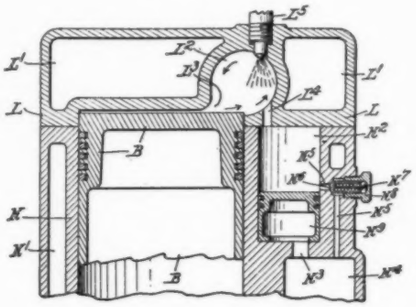
primary chamber, whereby said secondary chamber is charged by said blast with a quick burning fuel-air mixture, said secondary chamber being otherwise closed to entry of fuel.

2,154,505

VARIABLE VOLUME INTERNAL COMBUSTION ENGINE

Leigh M. Griffith, Los Angeles, Calif., assignor to Phillip Lane Scott, Chicago, Ill.

Application June 17, 1933. Serial No. 676,268
11 Claims. (Cl. 123 – 78)



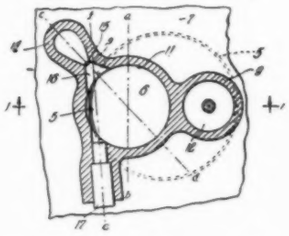
1. In combination in an internal combustion engine, a working cylinder, a piston therein, means defining a separate combustion chamber having communication with the working cylinder, and an auxiliary cylinder in communication with said combustion chamber and means movable solely in response to pressure variations in the auxiliary cylinder and combustion chamber for forcing gas from said auxiliary cylinder, into said combustion chamber, and means providing a throat between said working cylinder and said combustion chamber.

2,157,659

INJECTION ENGINE

Hans Fischer, Yonkers, N. Y., assignor to Lanova Corporation, Long Island City, N. Y., a corporation of Delaware

Application October 23, 1937, Serial No. 170,570
3 Claims. (Cl. 123 – 32)



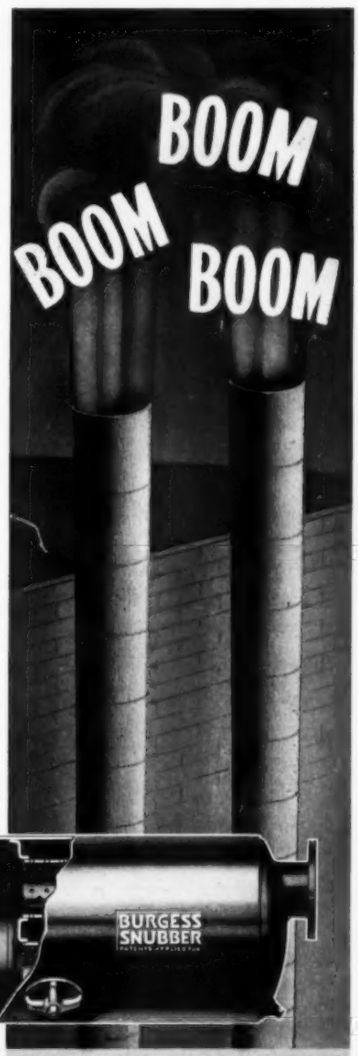
3. In an injection engine comprising a cylinder and a piston operating therein, a combustion chamber substantially elliptical in plan opening into said cylinder, a supplementary chamber opening into said combustion chamber through a restricted orifice and a funnel-like passage leading from said orifice flaring inward of said combustion chamber, said orifice and passage being disposed to direct a high pressure high velocity fluid stream ejected from said supplementary chamber across said combustion chamber along a horizontal line, and a fuel injection nozzle having a port disposed to inject a stream of fuel into said combustion chamber and into said passage along a second horizontal line in the same horizontal plane as said first horizontal line, said lines intersecting within said flaring passage at an acute angle, said first and said second horizontal lines being in different vertical planes, the distance between the port of said nozzle and said orifice and passage

. . . . *And now please turn to page 52*

PREVENT DIESEL NOISE

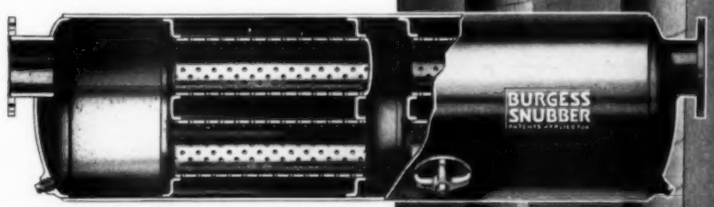
without Increasing Fuel Consumption

Ordinary exhaust mufflers build up peak back pressures which reduce engine efficiency and increase fuel consumption considerably. The Burgess Snubber utilizes an entirely new principle for dissipating the high pressure slugs of exhaust gas that are the cause of exhaust noise. It snubs these slugs of gas before they reach the atmosphere and provides a non-restricted passage for the gases exhausted during the scavenging stroke. Hence, the exhaust gas is bled off in a smooth, quiet flow, with no back pressure peaks. Noise is prevented without increasing fuel consumption.



Burgess Snubbers Require No Tuning

As the Burgess Snubber has no reso nators or acoustic devices, it does not require tuning. It can be mounted anywhere in the exhaust system, regardless of the length of piping. It is equally effective for quieting two-stroke and four-stroke cycle engines. Mail the coupon for further data.



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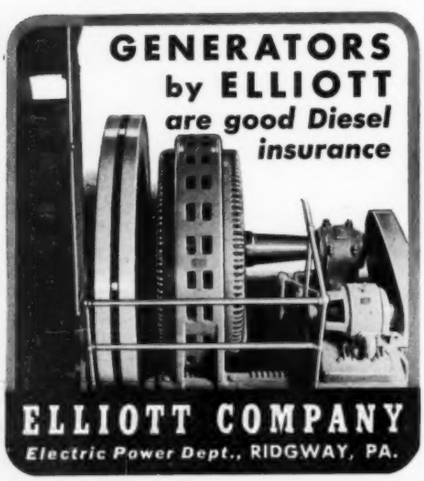

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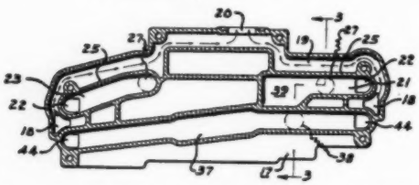
being such as to assure entry of injected fuel into said supplementary chamber in proper amount to form with the air therein a fuel air mixture so proportioned as to give the maximum rate of and complete combustion effective for ejecting a high pressure high velocity fluid stream from said supplementary chamber through said orifice and passage.

2,155,776

COMPRESSION IGNITION ENGINE

Oscar L. Starr, Mission San Jose, Calif., assignor to Caterpillar Tractor Co., San Leandro, Calif., a corporation of California.

Application July 6, 1937, Serial No. 152,089
14 Claims. (Cl. 123 – 173)



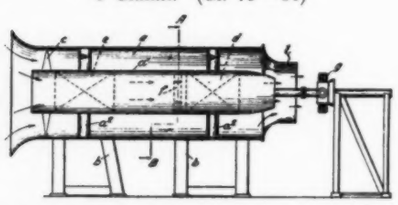
5. In combination, a main engine of the compression ignition type, an auxiliary starting engine positioned at one end of said main engine and in alignment therewith, each of said engines being water jacketed, means for coupling the water jacket of one engine to that of the other to provide a cooling system common to both machines, a hood over said engines, said hood having a portion above said auxiliary starting engine removed to provide an opening therethrough, and an oil filler tube mounted on said starting engine and extending upwardly through said opening.

2,158,894

TESTING PLANT FOR INTERNAL COMBUSTION ENGINES

Wilhelm Brintzinger, Berlin-Johannisthal, Germany

Application May 20, 1936, Serial No. 80,863
In Germany May 21, 1935
8 Claims. (Cl. 73 – 51)



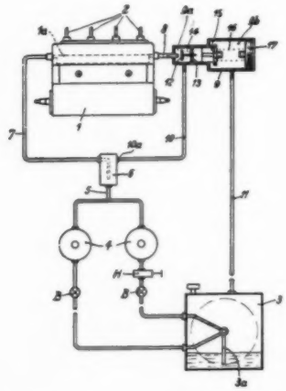
1. In a testing plant for internal combustion engines, particularly for motors for air craft of the character described comprising in combination: a braking device; a blower for producing cooling air for the motor being tested, a cylindrical wind channel within which the said brake and blower are arranged in axial alignment with said wind channel, said wind channel being shaped to provide a nozzle directing the cooling air towards the motor being tested.

2,157,737

FUEL DELIVERY APPARATUS FOR INJECTION INTERNAL COMBUSTION ENGINES

Johann Friedrich Janssen, Stuttgart, Germany, assignor to Robert Bosch Gesellschaft mit beschränkter Haftung

Application July 21, 1937, Serial No. 154,874
In Germany July 15, 1936
3 Claims. (Cl. 123 – 139)



1. Fuel delivery apparatus for injection internal combustion engines, comprising, in combination, a fuel injection pump, a supply tank and a fuel delivery pump for pumping fuel from said supply tank to the inlet chamber of said injection pump, an air separater between the delivery pump and said inlet chamber, a pipe leading from the lower fuel-containing portion of the separator to the inlet chamber, an overflow conduit, connected with said inlet chamber and said supply tank, a weakly-loaded back pressure valve arranged in said overflow conduit, said valve opening in the direction of the overflow, an additional higher-loaded back-pressure valve arranged in the overflow conduit between said first-mentioned valve and the supply tank, and a connection between the upper part of said separator and that part of the overflow conduit situated between the two valves, the first weakly-loaded valve preventing the injection pump from sucking air into the inlet chamber out of the space between the two valves while the second valve is so loaded that the desired fuel pressure is maintained within the system under working conditions.

2,153,264

SYNCHRONIZATION INDICATOR FOR INTERNAL COMBUSTION ENGINES

Charles I. McNeil, Bloomfield, N. J., assignor to Eclipse Aviation Corporation, East Orange, N. J., a corporation of New Jersey

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4—100 HP Anderson full Diesel engines—2 cylinders
1— 50 HP Anderson full Diesel engine—1 cylinder
1—1500 GPM De Laval Centrifugal Pump—2 stage—285 ft. head
1—1000 GPM Goulds Triplex Pump—13" x 16", 285 ft. head
2—600 cu. ft. Air Compressors, Chicago Pneumatic, 100#, 2 stage
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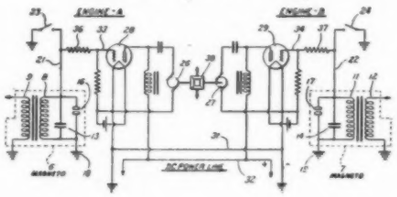
Application October 1, 1935, Serial No. 43,105
2 Claims. (Cl. 177 — 311)



1. In a system for indicating synchronism of a pair of internal combustion engines, each having a magneto with engine driven breaker points constituting a part thereof, a vacuum tube corresponding to each of said magnetos, each vacuum tube having its grid circuit alternately energized and de-energized by the opening and closing of the breaker points of its corresponding magneto to cause a pulsating current in its plate circuit, a pair of transformers to change said pulsating currents to alternating currents, a pair of synchronous motors operated by said alternating currents and differential means connecting said motors whereby an indication of the difference in frequency of interruption and hence of the speed of said engines is given.

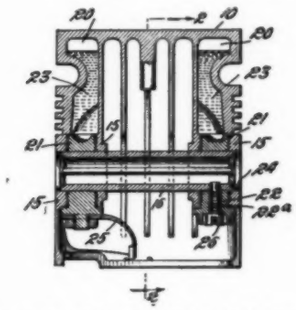
2,153,501

PISTON FOR INTERNAL COMBUSTION ENGINES

William Harper, Jr., Port Washington, N. Y., assignor to H. B. Motor Corporation, New York, N. Y., a corporation of New York

Application April 29, 1936, Serial No. 76,906
7 Claims. (Cl. 123 — 176)

1. A piston for internal combustion engines containing a plurality of sealed spaced pockets each extending for a fraction of the circumference of the piston and in said pockets a heat-



transfer medium in a movable fluid form which is agitated by the movement of the piston, so that the metal stresses are reduced by maintaining the whole piston structure at a more uniform temperature.

EIGHT COOPER - BESSEMER DIESELS FOR BATTLESHIPS NOW BUILDING

EIGHT Diesel-engine generating sets are now being built at the Grove City, Penna., plant of The Cooper-Bessemer Corporation, for eventual installation in the new battleships *Alabama, Indiana, Massachusetts* and *South Dakota*. These are the maker's Type EN, 6-cylinder Diesel engines, rated 300 hp. at 900 rpm., and will drive 200 kw. AC generators. Newport News Shipbuilding and Dry Dock Company will furnish one of these fighting ships, Norfolk Navy Yard will build another, New York Shipbuilding Corporation will furnish the third, and Bethlehem Shipbuilding Company the fourth. The eight Diesel engines and their generators will serve as emergency auxiliary units.

4 NEW YORK COACH LINES TO BUY 75 DIESEL BUSES

50 of 40-Passenger Vehicles to Go to Affiliates

THE Transit Commission at its meeting recently authorized the Fifth Avenue Coach Company and three of its affiliates to purchase seventy-five new buses to cost approximately $850,000. The three other companies involved are the New York City Omnibus Corporation, the Eighth Avenue Coach Corporation and Madison Avenue Coach Company.

Four orders adopted by the commission authorized the issuance of conditional sales agreements with the Yellow Truck and Coach Manufacturing Company, of Pontiac, Mich. The new buses will be of the forty-passenger type, equipped with General Motors Diesel engines and each bus will cost $12,215.

The Fifth Avenue Coach Company will get twenty-five of the new buses, the New York City Omnibus will get thirty, and the Eighth Avenue and Madison Avenue systems will get ten each.

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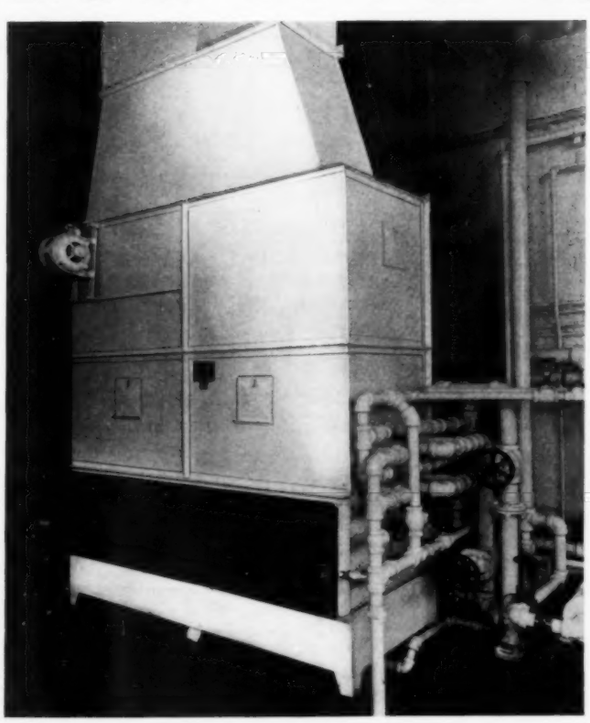

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DOMESTIC EQUIPMENT ORDERS REPORTED IN ISSUES OF THE RAILWAY AGE IN MAY, 1939

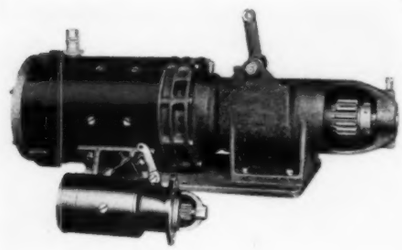
LOCOMOTIVES

Date	*Name of Company*	*No.*	*Type*	*Builder*
May 6	Atchison, Topeka & Santa Fe	13	Diesel-electric Sw.	Electro-Motive Corp.
		1	Diesel-electric	Electro-Motive Corp.
		12	Diesel-electric Sw.	American Locomotive Co.
		5	Diesel-electric Sw.	Baldwin Locomotive Works
May 27	Pere Marquette	1	Diesel-electric Sw.	Electro-Motive Corp.
May 27	Great Northern	14	Diesel-electric Sw.	Electro-Motive Corp.
May 27	Chicago, Burlington & Quincy	5	Diesel-electric Sw.	Electro-Motive Corp.

IN the May issue of *Railway Age* the above table appeared. Orders were placed in the United States during May for a total of fifty-one locomotives, all Diesel electric, as is indicated by the table. These purchases compare with a total of five locomotives ordered during May, 1938. The railroads of the country are constantly adding to their Diesel electric switching equipment because of the obvious proven economy of these units. There is also a steady increase in the number of main line locomotives bought by the railroads. We understand that the Chicago-Northwestern is equipping its famous "400" streamliners running between Chicago, Minneapolis, and St. Paul with Diesel locomotives. Other important announcements are due soon of additional railroads adopting these efficient, passenger drawing locomotives.

ELECTRIC CRANKING

CONSIDERABLE interest in Diesel circles has been aroused with the introduction by Delco-Remy of an electric cranking motor designed to crank Diesel engines of up to 9,000 cubic inch displacement. This cranking motor is illustrated below and compared in size with a standard passenger car cranking motor, which will develop about 1 hp. in cranking a 216 cubic inch displacement gasoline engine. The Diesel engine cranking motor is a 64-volt unit operated by a storage battery and will develop 40 hp. at the relatively higher cranking speeds required to start Diesel engines. Installations of this cranking motor on both stationary and locomotive Diesel engines in various sections of the country are being watched with interest. The simplicity of the installations and ease of operation are producing much favorable comment.



Delco-Remy cranking motor.

SERVING INDUSTRY

SUN OIL COMPANY has recently produced a well-prepared and interesting book entitled "Serving Industry" and we think our readers will find it well worth while writing to Mr. A. E. Aldridge, Sun Oil Company, Philadelphia, for a copy. This booklet covers the important phases of petroleum products which include striking oil in Texas—loading and transportation by pipeline and by tankship—refining the crude by a world renowned, exclusive process—and putting the finished products through their paces before they are shipped to industry.

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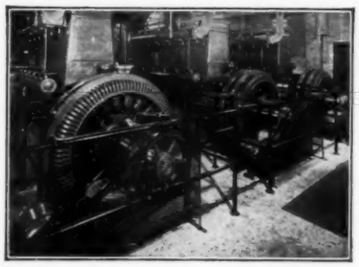

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C. H. ARBENZ APPOINTED

THE appointment of Mr. C. H. Arbenz to the presidency of the Hemphill Diesel Schools has been announced by the Board of Directors of this Diesel training institution.

C. H. Arbenz

Mr. Arbenz has been an executive of the organization for the past six years and has witnessed the wide Dieselization of industry in recent years, during which time the Hemphill Schools have grown from a local to a nationally operating training institution with schools located from coast to coast.

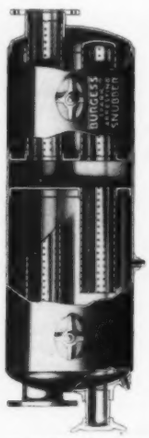
Mr. Arbenz has gained a reputation among his associates as a man of high ideals and his greatest aim is to render a service of real and lasting benefit to the young men students and graduates of the Hemphill Diesel Schools.

SPARK-ARRESTING SNUBBER FOR DIESEL ENGINE EXHAUSTS

IN many locations, flying sparks from the exhaust of Diesel engines are troublesome or hazardous. To trap these flying particles and at the same time prevent exhaust noise, the Burgess Battery Co., Acoustic Division, Dept. NR, 500 W. Huron St., Chicago, has developed a new spark-arresting type of Exhaust Snubber.

Like all Burgess Exhaust Snubbers, the Burgess SDHS Snubber snubs the slugs of high velocity exhaust gas which rush into the exhaust pipe and bleeds them to low pressure before any noise can be created. Hence, the Snubber prevents the building up of line surges and peak back pressures which cause high fuel consumption.

Two methods of spark removal are utilized in this design. First, because of the large cross-sectional path, the velocity of the gases is very low and the heavier particles tend to separate out by gravity. Second, the exhaust gases change direction and velocity so that the remaining finer carbon particles are thrown out due to centrifugal action. The carbon and ash drop into a large chamber in the bottom of the Snubber, where they can be removed through a hand hole.



Burgess SDHS Series Spark Arresting Snubber.

The SDHS Snubber does not require tuning and can be installed anywhere in the exhaust pipe system. It operates equally well with any kind of engine. However, it must be installed vertically.

Burgess SDHS Series Spark-Arresting Snubbers are available in 19 standard sizes with connections ranging from 2 to 30 inches in diameter — flanged to match standard 125-lb. American pipe flanges. The shells and heads are welded of extra heavy gauge steel to resist the corrosive action of the exhaust gases.

Burgess Spark-Arresting Snubbers allow Diesel engines to be operated in the most hazardous locations or in the most restricted residential zones where exhaust noises are not tolerated.

DIESEL LOCOMOTIVES OR STEAM

A COMPARISON of operating costs for the Southern Pacific Railroad's "Sunbeam" steam locomotives and the "Denver Zephyr" Diesel trains of the Burlington Railroad shows 80c per train-mile for the former and 62c for the latter. Their sizes are comparable. American results show, on the average, 65 per cent availability for steam and 90 per cent for Diesel trains.

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